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# THE SURGICAL CLINICS OF NORTH AMERICA

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Volume 4

Number 1

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By THOMAS A. SHALLOW, M. D.

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**CLINIC OF DR. CHEVALIER JACKSON****JEFFERSON HOSPITAL**

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**PYLOROSCOPY**

*Peroral pyloroscopy* with an ordinary open tube esophagoscope is a practicable procedure in all infants and younger children. It is practicable in only a few adults without a lens system in the gastroscope. The exploration of the left two-thirds of the stomach is a common procedure at the Bronchoscopic Clinic. The displacement required to bring the pylorus over

to the midline for inspection by the gastroscope is easily accomplished in very young children by the external abdominal manipulation of an assistant. This permits of inspection of the pylorus and duodenal folds are sometimes seen. In adults duodenal folds have been seen a few times, as previously reported. In most cases the open tube esophagoscope is used, the stomach folds being examined in the collapsed state of the stomach. In some cases it is found advantageous to use the inflating gastroscope (Fig. 1). In children the air is well retained and the gastric folds remain well back for a considerable time after the window plug is removed. At the Bronchoscopic Clinic we prefer to work without a lens system. If, however, a lens system is desired, the best instrument is the Janeway gastroscope, which is designed to be used after the open tube is passed by sight. This insures safety from the great danger incident to the blind passage of any instrument into the esophagus.

In our work with the Jackson open tube gastroscope we have found the left edge of the pyloric antrum easily reached in most adults. Some degree of displacement of the pyloric end of the stomach toward the left by external manipulation is

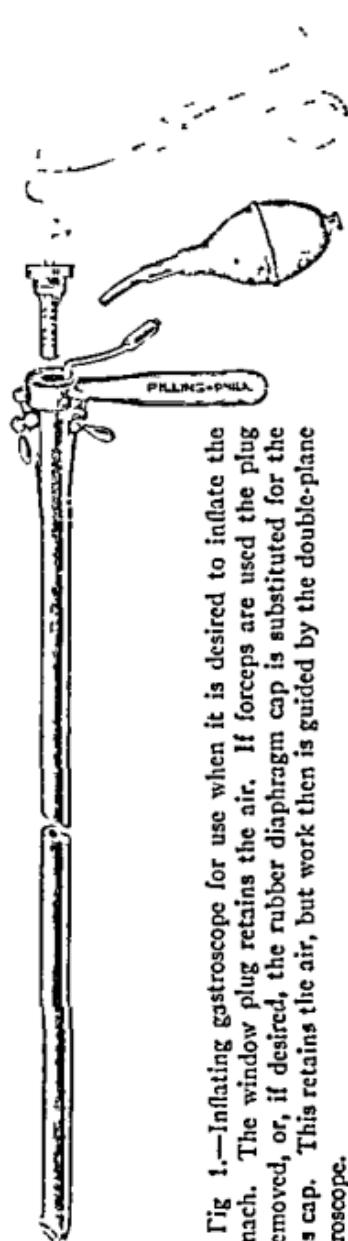


Fig. 1.—Inflating gastroscope for use when it is desired to inflate the stomach. The window plug retains the air. If forceps are used the plug is removed, or, if desired, the rubber diaphragm cap is substituted for the glass cap. This retains the air, but work then is guided by the double-plane fluoroscope.

necessary for this, and is usually accomplished without difficulty if there are no adhesions. The pylorus itself cannot often be brought over so far to the left. In cases of early cancer of the pylorus, before adhesions have formed, when the mass can be felt, the mass affords a handle, so to speak, by which the pylorus can be brought over. In these



Fig 2.—Roentgenogram showing a safety-pin jammed in the pylorus of an infant aged eleven months. The keeper branch of the pin was in the duodenum, the pointed branch hooked over the pyloric ring with the point against the stomach wall. The pin had been in this position a number of days. Pin removed through the mouth by peroral pyloroscopy without anesthesia, general or local. The barium shadow shows the colon. Film by Dr Willis F Manges.

manipulations it is well to remember the spine. The gastroscopic tube mouth must be kept close to the anterior wall and the pyloric end of the stomach must be manipulated anteriorly in moving it to the median line or beyond toward the left. The movability of the pylorus varies, but if there are no adhesions it can in many individuals be pushed across the mid-line into the splenic region. In tubular pyloric antra it is still

more difficult to get any presentation of the pylorus itself, though the antrum can usually be entered to some extent.

The following case affords a graphic demonstration of peroral pyloroscopy.

Case No. Fbdy, 1183. *Peroral Pyloroscopy for Foreign Body.*—This female child, aged eleven months, swallowed one of a number of safety-pins left in her reach by the mother. The pin was found to be in the stomach on Roentgen-ray examination by Dr. W. H. Schmidt, who referred the case to the Bronchoscopic Clinic. Daily observations of the movements of the pin in the stomach were made by Dr. Manges. It finally became wedged in the pylorus, the keeper branch being in the duodenum and the pointed branch in the stomach, with the point buried

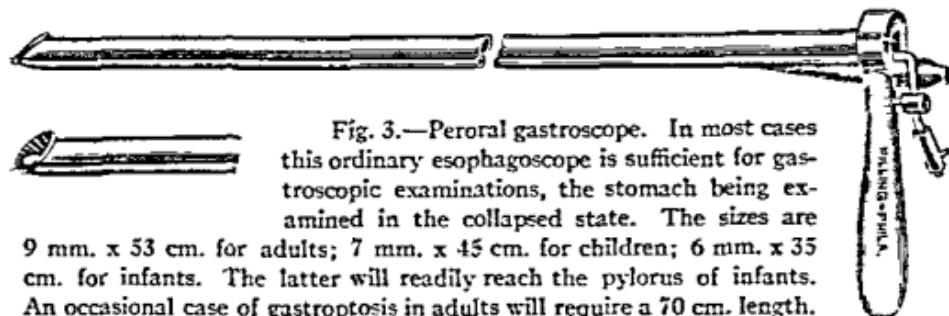
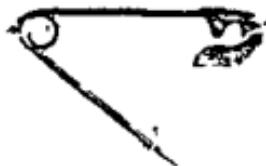


Fig. 3.—Peroral gastroscope. In most cases this ordinary esophagoscope is sufficient for gastroscopic examinations, the stomach being examined in the collapsed state. The sizes are 9 mm. x 53 cm. for adults; 7 mm. x 45 cm. for children; 6 mm. x 35 cm. for infants. The latter will readily reach the pylorus of infants. An occasional case of gastropostis in adults will require a 70 cm. length. A window plug, as shown in Fig. 1, is used when inflation is desired. The hand-ball has a relief valve for deflation.

in the gastric mucosa and preventing the passage of the pin, according to localization of Dr. Manges (Fig. 2). After the intruder had remained in this position for five days it was deemed dangerous to wait longer. It was therefore removed through the mouth with the pyloroscope (Fig. 3).

*Peroral Pyloroscopy.*—Inflation of the stomach through the pyloroscope did not dislodge the pin, thereby verifying the localization of Dr. Manges as to the hooking of the pin over the pyloric ring with the keeper in the duodenum. The extreme anterior position of the pin necessitated so great an anterior displacement that the trachea was closed by the pressure, necessitating frequent interruption of the work to allow the baby to breathe. A number of attempts to withdraw the pin

dragged the pylorus, duodenum, and other viscera to the left a distance of about 7 cm., the viscera each time going back to position when released, as observed by Dr. Manges with his double-plane fluoroscope. In a few minutes, however, the pin (Fig. 4) was dislodged from the pylorus. It was then seized and straightened against the tube mouth and withdrawn along with the pyloroscope. The entire procedure required twenty-four minutes and fifty-three seconds. No anesthetic, general or local, was used. The child was immediately taken to its home in the city by its mother and given the breast, which it took normally. The next day it was brought back for examination and found



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Fig. 4.—Safety-pin removed from pylorus and duodenum of an infant by pyloroduodenoscopy without anesthesia, general or local.

to be perfectly normal and happy, and it has had no trouble since.

This case illustrates beautifully the procedure of peroral pyloroscopy because the Roentgen ray afforded a graphic record of the procedure, the pin being fixed in the pylorus with the keeper in the duodenum.

The technic of introduction of the peroral gastroscope is minutely described in a recent text-book.<sup>1</sup>

*Gastrostomie pyloroscopy and duodenoscopy* are procedures of great usefulness in diagnosis and treatment. They have been in use at the Bronchoscopic Clinic for many years, and are

<sup>1</sup> Bronchoscopy and Esophagoscopy, 1923, W. B. Saunders Co.

being further developed by Dr. Louis H. Clerf and Dr. Gabriel Tucker. So far the work has been done in cases in which gastrostomy was required independent of the endoscopic procedure; but there are cases of duodenal conditions in which it is advisable for the abdominal surgeon to leave a gastrostomic tube in the stomach to create a fistula through which to treat the duodenum, and we think the day is not far off when a gastrostomy will be done for this especial purpose.

Many local lesions of the stomach and the adjacent part of the duodenum are amenable to local measures applied by swabbing, injection, or other instrumentation through the retrograde gastroscope or pyloroscope. We do not advocate local treatment as a substitute for surgery; but such cases of duodenal trouble as fail to improve after gastro-enterostomy may yield after pyloroscopic treatment has been added to the duodenal rest afforded by the gastro-enterostomy. For this, of course, a gastrostomy would be necessary. The best position for a fistula for pyloroscopy is as near the median line as possible at about the level of the pylorus.

To find the pylorus with the pyloroscope, if the gastrostomie fistula is far to left, the tube mouth must be brought anteriorly to avoid the spinal bulge, causing more discomfort to the patient by the angulation of the fistula.

Regardless of the position of the gastrostomie fistula a string may be followed as a guide after the string has been passed by peristalsis far enough into the intestines to anchor it, as will be demonstrated to you by Dr. Gabriel Tucker.

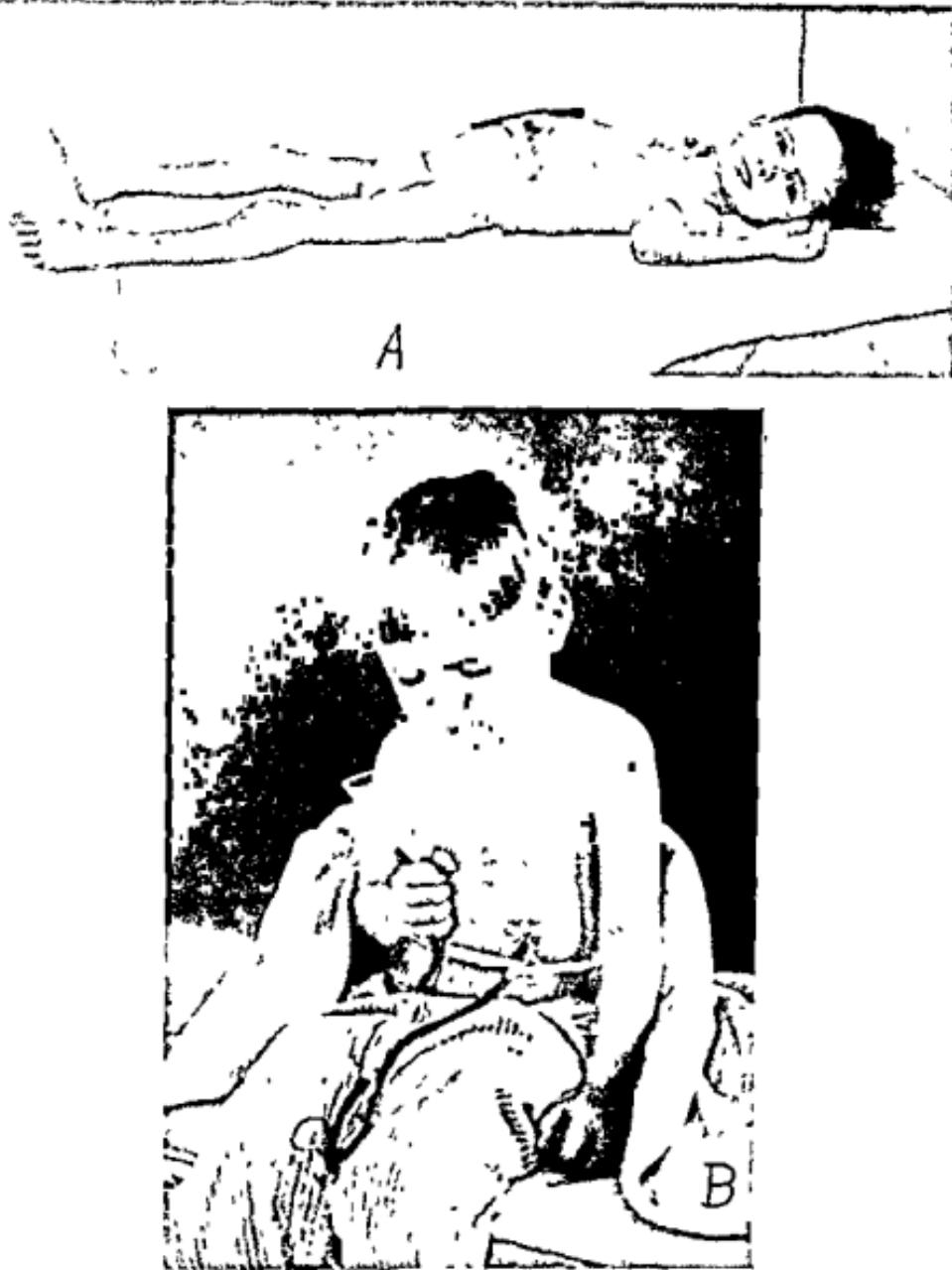


Fig. 5—A child aged three and a half years with total atresia due to swallowing lye. Gastrostomy saved this child's life. He did not improve in nutrition (A), however, until he spat his overflow of saliva into his stomach through the funnel (B). Failure to get good results from gastrostomy is often due to lack of saliva in the stomach.

There was not a second to be lost if that child's life was to be saved Food was immaterial for a time, but water those tissues must have at once, if, indeed, it was not already too late for them to take it up Not many such patients can be saved

Murphy drip and hypodermoclysis were started at once and we were all glad to find the patient reacted favorably

Then we called upon our surgical colleagues for a gastrostomy It was done by Dr Thomas A Shallow in fourteen minutes, the child made a good recovery To the gastrostomy she owes her life and health not only because of the rescue in the emergency but because of the relatively rapid cure which it enabled Dr Tucker to obtain by retrograde methods

Why did we call upon our surgical colleagues for a gastrostomy?

We had the utmost confidence in our ability ultimately to cure that esophageal stenosis Then why do a gastrostomy?

1 Esophagoscopy showed a mass of scar tissue which we knew from appearances taken together with the history had been building up for two years This meant that results of treatment could be obtained only slowly if safe methods alone were to be employed Rapid dilatation by any method is dangerous The wall of the stenotic lumen in the esophagus in this case is, as frequently occurs, cicatricial only in one segment Part of the wall is thin, normal wall A normal wall segment will yield enormously to slow dilatation extended over a long period of time, but it would inevitably rupture long before the cicatricial segment would yield if rapid dilatation were attempted A normal wall segment will not subsequently contract as will cicatricial tissue

2 To stop the static esophagitis, such as was present in this patient, the esophagus should be put at rest

3 There were at least three tight strictures, excentric to each other, and separated by a tortuous lumen whose walls were made up partly of distorted, contracting, fibrous tissue built up in two years of ulceration

In such conditions the best, safest, and shortest in duration

of all safe methods of cure is with the Tucker retrograde bougie. This method necessitates gastrostomy.

4. Gastrostomy is quickly done, under local anesthesia if necessary, and is associated with almost no mortality if considered apart from the condition for which it is done.

5 Failure to get good results from gastrostomy is usually due to too long delay in its performance and to the use of ether in water-starved patients

A few words as to the treatment of the cicatrical stricture in such a case. As you know, I have spent thirty odd years of my life in the development of esophagoscopic methods. No one could be more enthusiastic over the value of those methods than one who has seen thousands of lives saved thereby. Experience has shown me that in the milder cases, seen early, peroral esophagoscopic methods alone will cure almost all such cases. But when the strictures are multiple and eccentric, with a long devious lumen, the Tucker retrograde bougie is the instrument of choice. In deciding which method to employ, the esophagoscopic appearances are the chief factor. The Roentgen ray is the only means of determining the size and shape of the strictured lumen between points at which the peroral and the retrograde esophagoscopes are stopped by small tight strictures. If this distance is short and the lumen not devious, esophagoscopic methods alone will cure quickly and safely, using a steel-stemmed filiform. If the passage is long and tortuous the Tucker bougie can be drawn upward following the lead of the string around all the angles and curves with perfect safety. Dr. Tucker does not claim to be the originator of string methods. They have been in use, as he has said, for thirty or forty years, since advocated by Abbe, Mixter, and others. Ochsner drew up a folded piece of rubber tubing; Eilenberg drew up catheters. Gabriel Tucker devised a bougie that will gradually and safely dilate a stricture in the shortest possible time consistent with safety and without trauma or even irritation of the mucosa. Mucosal trauma means subsequent cicatrices, and it is cicatrices that we are combating. We do not want to add to the cicatrices already present in these cases.



ture, if we allow the passage and the stagnation of foods to persist by delaying gastrostomy. An early gastrostomy will stop all this. This was the state of affairs in Case III. Early gastrostomy promptly stopped the formation of cicatricial tissue, and we cured the child in a few weeks. What is equally important, her stenosis will never recur. Patients thus cured twenty years ago are still swallowing normally.

Here we have a chalk sketch of the endoscopic appearances of a cicatricial stenosis of the esophagus resulting from two years of chronic ulceration, chronic static esophagitis from neglected lye burn (C). This was the condition in Case II. You will note the whitish scar tissue. Here to the left we have the eccentrically placed lumen of the stricture. The left wall of this stricture is normal esophageal wall which will yield to slow dilatation, but will rupture before the cicatricial segment will yield. Rapid dilatation is sure to be fatal in such cases. The extent to which normal esophageal wall will yield is shown in the disease miscalled "cardiospasm," the dilated esophagus in some cases being large enough to contain a fetal head. And we know such dilatations never contract.

Here we have the lumen of a cicatricial stricture occluded with granulations (D). If prompt measures are not instituted the lumen will be obliterated by the organizing and cicatrizing of the interlocking granulations. At this stage, by peroral or by retrograde esophagoscopy or by both combined, two endoscopists co-operating, a string can be put through and cicatricial atresia can be prevented, and the lumen can be dilated.

Here we have a total cicatricial atresia (E) which could have been prevented by early gastrostomy and stringing. To cure this total obliteration a start has to be obtained by combined peroral and retrograde esophagoscopy. Instrumental perforation from one tube to the other is made, preferably with forceps, which are used on withdrawal to pull through a very small filiform bougie carrying a string. The procedure requires the utmost precision and is not totally free from mortality, but is advisable in cases in which gastrostomy has been delayed too long and obliteration allowed to occur.



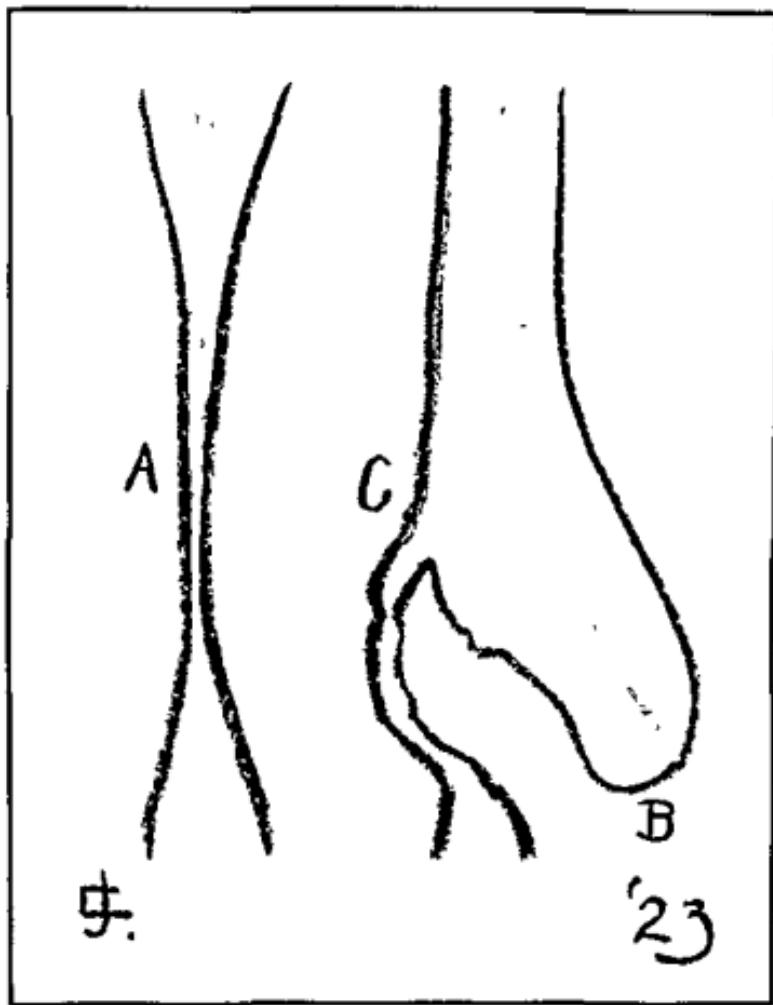


Fig. 7—Chalk talk on gastrostomy by Chevalier Jackson. Reproduction of the author's chalk drawings, showing one of the reasons why Trousseau said that all patients with esophageal stenosis died of the bougie, which was blindly passed in his day. The physician thinks the bougie is in the funnel-shaped entrance to the stricture (A), when, in reality, it is in a pocket (B), and not in the excentrically located stricture (C). This danger is avoided with the esophagoscope as shown at Fig. 6, F.

Here you see ( $\Gamma$ ) the reason why the immortal Rousseau said that sooner or later all patients with esophageal stenosis died of the bougie. The lumen of the stricture is above the level of the floor of the dilatation which does not lead into the lumen of the stricture. This is one of the reasons why blind peroral bouginage is dangerous, though often normal wall is perforated. Its dangers are entirely avoided by gastrostomy and retrograde bouginage.

I shall now draw a schema of this (Fig 7) as it would be seen in the vertical plane. The physician thinks his bougie is engaged in a funnel shaped entrance to a stricture (A), when, in reality, it is engaged in a pocket (B) and not in the excentric stricture (C). A very gentle push will perforate at B.

Gastrostomy is contraindicated in all cases in which a cure can be obtained quickly by esophagoscopic methods alone provided the patient is not in an extreme condition.

Esophagoscopic examination should precede any form of treatment except gastrostomy for water starvation. Blind methods undertaken with no knowledge of the condition of the esophagus are exceedingly dangerous. Nearly every pathologic museum has one or more specimens showing esophageal perforation by blind bouginage.

## CLINIC OF DR. THOMAS McCRAE

### JEFFERSON HOSPITAL

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#### THE DIAGNOSIS OF A FOREIGN BODY IN A BRONCHUS

THE problem of diagnosis of the presence of a foreign body in a bronchus offers fascinating possibilities. It may be an extremely easy problem or a most difficult one. There are several general points which are worthy of mention before we study the patients. (1) It is essential to realize that foreign bodies not infrequently gain entrance to the air-passages. This possibility should always be kept in mind in obscure pulmonary or bronchial conditions. It is important not to make light of a history which suggests that a foreign body may have been aspirated. Patients often come with the account that no one believed that it was possible that a foreign body could have gained entrance to the air-passages. Sometimes this view is taken because the symptoms were slight. It is essential to remember that a foreign body may gain entrance with comparatively little disturbance. (2) There is a great difference in the immediate results which follow the aspiration of a foreign body into a bronchus. Certain substances, such as a safety-pin, may occasion comparatively little disturbance; others may set up a very acute process and be dangerous to life. Among the latter the peanut takes first place. (3) The symptoms and signs which may result can evidently occur in great variety. The size of the foreign body may determine where it lodges, high or low, in the bronchus, the substance aspirated may set up very different degrees of irritation and inflammation. The amount of resulting secretion varies greatly. Air may be shut off entirely from the portion of lung supplied by the bronchus; air may be allowed to pass in and out with each inspiration; or may be allowed to pass in and not out. In the same way

the secretions may be completely retained escape freely, or escape at times only. The foreign body itself does not necessarily remain in one position, but may pass into the bronchus of another lobe or over to the other side. (4) The secretion which is brought up from the affected bronchus may pass over into the bronchi of the other lung and give signs there. (5) The affected portion of lung may be overdistended with air if the foreign body has a ball valve action, the air may be absorbed, the lung may collapse or there may be accumulation of secretion and the tissues become "water logged."

You may say "Why bother about the physical signs? The x ray study will give the diagnosis." In the first place, we should always try to make a diagnosis by the use of our own senses and brains. In the second place, the plate shows the foreign body only if it is opaque but many are non opaque. In the case of non opaque foreign bodies only a radiologist skilled in the interpretation of these plates can give an authoritative opinion. The more we learn of the physical signs, the more likely are we to recognize cases in which there may be no suspicion of a foreign body from the history.

In the diagnosis by the x ray study there is naturally some difference between the recognition of opaque and non opaque bodies. For the radiologist the opaque foreign bodies are naturally easier, but, as Dr Manges has demonstrated in his work, it is possible with careful study to be as sure by the x ray study of the position of a foreign body when it is non opaque as when it is opaque. In the making of a diagnosis by symptoms and physical signs there is no difference between opaque and non opaque foreign bodies. The resulting signs may be exactly the same in either case. I desire to emphasize this as many men are too much inclined to trust to the x ray diagnosis and not realize that by careful study of the signs it should be possible to be about as accurate in diagnosis as the x ray study can be when made by a skilled observer in the case of non opaque bodies, and much more accurate than when made by an observer not skilled in the interpretation of plates from these cases.

The 2 patients to be shown illustrate some of the problems

**Case I.**—The patient is a boy aged three years, admitted on November 23, 1923. The statement of his mother is that he has a very severe paroxysmal cough. The child's past history is absolutely negative. His present illness began on November 14th, nine days before admission, when the child had a handful of peanuts which he was eating. It was noticed that he put his hand to his mouth and almost immediately began to cough and to gag very severely. The child was put to bed. He soon had fever, the exact grade of which we do not know, and the severe cough has continued until the present.

You will agree that this is a very suspicious history. Of course, we are impressed by the folly of giving peanuts to a child aged three years, but dietary indiscretions are a common failing in adults as regards their own diets, and it is not surprising that they offend in regard to their offspring. The fact that he was eating peanuts at the time of the onset of symptoms is very suggestive. The occurrence of fever afterward is also suggestive, as it is a constant happening in cases in which the foreign body is a peanut.

*Examination.*—The child is restless and frightened, so that examination is not very easy. There is considerable cyanosis without any marked dyspnea at the present time. No wheezing is heard. There are frequent attacks of coughing, which are paroxysmal and convulsive. On inspection it is evident that there is diminished expansion of the lower right side. The left side expands freely and is clear on percussion and auscultation. Perhaps the percussion note is slightly hyperresonant. On the right side the note over the upper right lobe and middle lobe seems quite clear and perhaps slightly hyperresonant. Over the lower right lobe there is quite marked dulness. Over this area the breath sounds are very distant and heard with difficulty, not a single râle can be heard. The breath sounds over the middle and upper right lobes are loud and harsh, and not a single râle is heard over them. It is difficult to make a satisfactory observation of the movements of the costal margins and of the position of the heart, as the child is so restless; if any displacement of the heart is present it is apparently slight. It

is not possible to observe vocal fremitus. A restless, crying, squirming child is not the best subject for accurate observation of physical signs, but the difficulty makes patience and accuracy all the more important.

*Remarks*—It is evident that the signs of change in the lung tissue are confined to the lower right lobe, and our business is to try and settle what is the cause of it. The marked dulness suggests absence of air from the lung or a marked pleural effusion. It is perhaps well to digress here for a moment to comment on the fact that the diagnosis of pleural effusion either serous or purulent, is made very often in patients with a foreign body in a lower lobe bronchus. When you consider the signs present here some excuse for this error is evident, but there is little if any excuse if a careful study is made. Can we exclude the presence of pleural fluid in this case? There are several points against it. (1) The feeling of resistance is not that of fluid, but of some alteration in the lung itself. This is a most valuable sign, and to it, in my opinion, the greatest weight should be given. The recognition of the character of the resistance on percussion—best by direct percussion—is a most valuable point. This is especially true in a child in whom we are unable to obtain vocal fremitus satisfactorily. (2) The dulness does not correspond in outline with that due to fluid, and it does not shift. The resonance over the middle lobe is well marked, there is no decrease in its extent. (3) Displacement of the heart does not help us much, as, if the dulness is due to fluid, it is not enough to cause any marked change.

The other common error in these cases is to make a diagnosis of pneumonia. The very distant breath sounds are against an ordinary pneumonia, although the fact that the child has a temperature of 102° F., a pulse of 120, and respirations of 32 might suggest it. Distant breath sounds are not uncommon in pneumonia, but a complete absence of rales is unusual. The diagnosis of pneumonia is frequently made in foreign body cases, but I have yet to see a case in which it occurred. Another condition which results in absence of air from the lung is collapse. There is no suggested cause for collapse in this case.

apart from the presence of a foreign body, and if it was present the heart would be markedly displaced to the right. Besides, "idiopathic" collapse is not likely to last for as long as this condition has done. The signs suggest that the air supply is cut off from the lower right lobe, and we naturally suspect that something is blocking the bronchus. Dr. Jackson sometimes asks "Are there sufficient signs to justify bronchoscopy?" Here there is no difficulty in saying "Yes, the signs suggest the wisdom of bronchoscopy." As to how much the change in the lower right lobe represents exudate in, and how much collapse of the lung, it is difficult to say from the physical signs in this case. If the child would give us a chance to examine him satisfactorily it is evident that the position of the heart would be of great value. If there is collapse of the lung to any extent, the heart would be moved over to the right. The x-ray study shows definite changes in the lower right lobe, which are interpreted as largely due to exudate and possibly slightly to collapse.

Bronchoscopy was done by Dr. G. Tucker. The larynx and trachea were found to be inflamed and there was free pus in the trachea, which apparently came from the right bronchus. A portion of a peanut was removed from the lower right lobe bronchus, the mucosa of which showed a great deal of swelling and a granular appearance. Immediately after the bronchoscopy the breath sounds and many coarse râles were heard over the lower right lobe. The absence of râles before the bronchoscopy over the affected portion of lung is an interesting point. For their production the presence of air is necessary, and it is probable that the air had been absorbed and that the bronchi were full of secretion. Why there were no râles heard elsewhere is puzzling as usually with the intense bronchitis they are numerous.

*Remarks*—It is evident that the removal of a portion of nut does not mean that other particles are not present, and time with further study is often required to settle this point which has come up in a number of cases in which the child was chewing at the time of aspiration, so that many small particles may be aspirated. The subsequent course in this patient is of

interest. The respiratory distress and cyanosis disappeared, but some diminished expansion and dulness over the lower right lobe continued, on quiet breathing the breath sounds were still quite distant, but were fairly well heard on deep breathing. On some examinations no râles were heard, at other times they were numerous. This takes us back almost to the condition on admission, and brings up the question as to whether there is still a foreign body remaining in the form of a small portion of peanut or whether the symptoms are due to the results of the presence of the foreign body which was removed. One has to remember that there is considerable swelling of the mucous membrane, which may result in partial or complete blocking for a few days. The child gradually improved, from December 10th to 20th the examination still showed diminished expansion in the lower right side, with some dulness the breath sounds gradually becoming more marked, and accompanied by many medium and coarse râles. During this time the general condition improved and the child was perfectly comfortable.

The results of a second bronchoscopy on December 8th are of importance. Pus was still found in the trachea, the right bronchus was filled with thick pus, the mucosa was granular and swollen, quite marked granulations were found in the lower lobe bronchus, but no foreign body was made out.

For the first two or three days in the hospital the child's temperature rose to about  $102^{\circ}$  F., after this it gradually came down and reached normal very slowly. It was normal practically for ten days before discharge.

This persistence of signs after the removal of a foreign body is not very rare in the cases in which the foreign body is a nut or some substance, such as a head of timothy grass small portions of which may have been aspirated or detached from the main portion. Intense inflammatory changes are set up there is a great deal of exudate, and in some cases there may be a rapid formation of fibroid tissue. Two possibilities have to be kept in mind. One is that there may be a very small portion of peanut embedded in a small bronchus, enough to keep up some irritation, but without causing obstruction except in a very

small area, too small to be recognized. The other is that the signs are due to changes in the lung tissue. Time is the great aid in answering this question. It is evidently impossible to exclude the presence of a very small portion of nut when one remembers that if the child was chewing the nut at the time of expiration, small portions may have been aspirated. This child was discharged on December 21st, after his temperature had been normal for ten days. This suggests that all the peanut has been removed. In all probability the lung condition will clear entirely.

**Case II.**—The patient, aged three years, was brought on account of dyspnea, wheezing respiration, and cough. There is nothing of importance in the past history. About three weeks ago the mother gave the child some candy which contained peanuts. The child disposed of one piece without difficulty. While engaged on the second one she suddenly choked, and the mother states that she became quite black in the face and gagged. In a short time the choking was relieved, but difficult breathing and wheezing respiration persisted. It is stated that the child had fever.

**Examination.**—On admission the temperature was 104° F., the pulse-rate 140, and the respirations 38. The child was restless, but did not show any respiratory distress, and there was no wheeze audible at the time of examination. On the right side the expansion was somewhat limited in the lower part of the thorax. The percussion note was rather hyper-resonant over the upper right lobe and about normal over the middle lobe; there was slight impairment in the lower right axilla, and over the lower right back there was a combination of tympany with dulness. The note was clear on percussion over the left lung, and on auscultation the breath sounds were harsh with an occasional coarse râle. The findings were very much the same in the upper and middle lobes on the right side. Over the lower right lobe the signs were varied. At times inspiration could be heard rather distantly, at other times not at all. Expiration when heard had a wheezing quality. No râles were heard over the lower right lobe.

*Remarks*—These signs are evidently rather puzzling. They are most marked in the lower right lobe, suggesting some obstruction, which varies somewhat in degree and is apparently not complete. The signs in the upper right lobes and throughout the left lung are suggestive of some secretion in the bronchi. The possibility of small pieces of material in several bronchi cannot be excluded, but does not seem likely, owing to the small number of rales. The x-ray study showed considerable shadow regarded as due to exudate, in the lower right lobe, with some emphysema of the upper lobe. The signs in this patient are very similar to those found in the first patient, and the same points apply in the diagnosis. The variation in the signs especially on auscultation, suggests that the obstruction is not complete. Here again the absence of râles is unusual, as there was no doubt of the presence of bronchial secretion, which was proved by the inspection during bronchoscopy.

Bronchoscopy was done on December 5th by Dr. Chevalier Jackson. Just before the bronchoscopy the patient was examined and the signs found practically as given above. They were especially in the lower right lobe. Upon insertion of the bronchoscope by Dr. Jackson the patient became very cyanotic. The right bronchus was found intensely inflamed, large quantities of pus came out, and the walls were lined with granulation tissue, but no foreign body was found. The other side was explored and the peanut was found in the *left* bronchus about the orifice of the left upper lobe bronchus. Here it is evident that the peanut shifted. It is difficult to state exactly when this occurred. Dr. Jackson thought it was probably on the introduction of the bronchoscope, and that this was responsible for the marked cyanosis. The situation where the peanut had been in the right bronchus was very plainly marked by the local changes.

*Remarks*—The finding of the peanut in the left bronchus might have raised doubt as to its ever having been on the right side—in the mind of a captious critic—but the inspection of the right bronchus showed that it had been there. This shifting of a foreign body is not very uncommon, and suggests the wis-

dorm of always examining the patient shortly before the bronchoscopy is done. There is also the possibility—which, however, is rare—that the foreign body may have been coughed up, and perhaps swallowed, so that it is not found before the bronchoscopy.

The child did well and was discharged a week after bronchoscopy, with the signs almost completely gone. Expansion of the lower right side was almost equal to the left, but there was still slightly less resonance on percussion and the breath sounds were harsher than normal.

**Discussion.**—These 2 patients illustrate some of the problems of diagnosis of a foreign body in a bronchus. Neither patient represents the features of maximum severity which may result from the presence of a peanut in a bronchus. However, both children were acutely ill, and in all probability both would have died, or the condition resulted in a lung abscess, if the portion of nut had not been removed. In a very small proportion of cases the foreign body is expelled in the act of coughing, but this should never be expected. The man who held that diagnosis must precede proper treatment was formerly regarded in some quarters as a therapeutic nihilist—not by thinking men, however—but here is an instance in which exact diagnosis is a necessity for intelligent therapy. A common error in all forms of foreign body, and particularly when the object is a nut, is to regard the condition as pneumonia. If we study the physical signs of these cases we can see why this mistake is made and also how it can be avoided.

The pathologic process is a most intense purulent bronchitis—septic bronchitis if you wish—which causes toxemia, fever, and asphyxia, and gives signs which may be fairly general and suggest diffuse involvement of the lung. The picture is much like that formerly described as capillary bronchitis or suffocative catarrh. In the marked cases the child is very ill, with high fever, toxemia, dyspnea, cyanosis, a very rapid pulse and respiration rate, and marked signs, particularly on auscultation. A superficial examination without careful study of the physical signs suggests pneumonia very naturally. To learn how to avoid

this error let us go over the signs found when the various possible occurrences are considered

1 The foreign body obstructs the main bronchus to a lung. There are several possibilities (a) There is a ball valve action, allowing air to pass in but not to pass out. The lung is over-distended and the affected side is larger, but it does not alter with respiration. The percussion note is hyperresonant or tympanitic. There may be breath sounds heard with inspiration and perhaps some medium or coarse râles, but usually by the time the patient is seen nothing is to be heard. These signs should not suggest pneumonia. (b) There is complete obstruction of the bronchus. After this occurs the air in the lung is rapidly absorbed. Until this happens there is usually tympany with absence of breath sounds. There may be some coarse rales, but not the fine râles suggestive of early pneumonia. As soon as the air is absorbed one of two things results, or a combination of them. There may be collapse of the lung or secretion occurs into the tissues and air cells, so that the lung is "water logged". In either case there is dulness with absence of breath sounds and rales. This is not common in pneumonia unless with a pleural exudate, and this would be of unusual extent to cover the whole lung. The recognition of collapse is aided by displacement of the heart *to the affected side*, and this is marked in the collapse of a whole lung. In pneumonia the heart is not displaced. In the lung full of secretion the absence of breath sounds and rales is very suggestive.

The condition of the other lung may be puzzling if there is much secretion from a bronchitis or secretion which has passed over from the affected side. The breath sounds are harsh and there are many coarse râles, but the percussion note is clear and there is good expansion.

Even if the general picture suggests pneumonia, a careful study of the physical signs should immediately raise a doubt, and if you are once suspicious of the correctness of a diagnosis of pneumonia it is safe to feel that it is probably something else. But you may still be unconvinced. As further evidence we must turn to the experience of past cases. Patients with these varying

collections of signs have been followed after removal of the foreign body. The alteration in the physical signs may be immediate and their rapid disappearance is proof that consolidation did not exist. The subsequent x-ray studies bear this out. A lung which is collapsed from blocking of a bronchus returns to normal very rapidly, and a lung full of exudate clears in a surprisingly short time.

2. The foreign body obstructs the bronchus to one lobe. This is usually a lower lobe, and more often on the right than on the left side. There may be the same variety of conditions as when the foreign body is in a main bronchus. Both the patients shown illustrated the problem of diagnosis, which need not be discussed again in detail, but a warning against mistaking the condition for empyema is in order, as this error is so frequently made. A number of patients have come to Dr. Jackson in whom the pleura had been opened for a supposed empyema, and in a larger number aspiration had been done. This latter is a perfectly correct procedure if one is in doubt, but a careful study of the physical signs should render it necessary on very rare occasions if at all. Empyema does occur in a very few cases of foreign body; in all that we have seen this has been after the foreign body has been in the bronchus for a long time. There was no difficulty in recognizing the presence of fluid from the physical signs, among which the feeling of resistance deserves an important place, probably the first.

**Conclusions.**—There is nothing mysterious about the diagnosis of a foreign body in a bronchus. It demands care in securing the history and in observing the physical signs. There is a story of a pious old lady who every morning offered up the prayer "Deliver me from hasty judgments." It is often a hasty jumping at conclusions, without proper observation of the signs or careful reflection over them, which leads to error. We should strive to make as accurate a diagnosis by the symptoms and signs as can be given by the x-ray study. Patience and thoroughness are essential; repeated examinations may be necessary. Your ability to recognize the presence of a foreign body in a bronchus may save the patient's life in some cases and prevent long-continued ill-health and invalidism in others.

## CLINIC OF DR. ELMER H. FUNK

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### THE RELATION OF BRONCHOSCOPY TO THE TREAT- MENT OF LUNG SUPPURATION

BEFORE discussing the relation of bronchoscopy to the treatment of lung suppuration it is well to recall that etiologically and pathologically, and to a certain extent clinically, suppurative processes in the lung possess no important differences from suppurative lesions occurring elsewhere. A suppurative lesion may result from pyogenic infection reaching the lung by way of the air-passages, blood, lymphatics, and extension from contiguous structures. The resulting lesion may be acute or chronic, single or multiple, circumscribed or diffuse, and involve one or more lobes. When the lung lesion is near the surface, pleurisy is very common and may lead to a purulent effusion. A lesion which closely simulates abscess or may be associated with it is bronchiectasis. Clinically, the chronic localized lesions of abscess and of bronchiectasis are differentiated with difficulty.

Pulmonary suppuration is recognized more frequently today than formerly. This is probably due to an increased incidence, as well as to more frequent recognition. The internist who sees most of these patients is being called upon more frequently than in the days gone by to decide upon the therapeutic procedure. Graham, in an address last year before the California Academy of Medicine, said that "abscess of the lung constitutes one of the most difficult conditions to treat satisfactorily that occurs in the category of non-malignant affections." In the acute and disseminated and multiple abscesses little can be expected from any form of treatment. On the other hand,

Jackson has shown that in the localized lung suppuration associated with foreign body lodgment, clearing occurs in a remarkable way after bronchoscopic removal of the foreign body. This is true even when the foreign body has had a long sojourn in the lung. In the localized suppurative lesions not due to foreign bodies spontaneous evacuation sometimes occurs and the patient recovers. This possibility has led many physicians to pursue an expectant attitude in the treatment of lung abscess. In many instances, however, evacuation fails to be complete, so that while considerable expectoration continues, the general symptoms, such as fever, do not subside and the patient gradually becomes worse with progressive loss of weight and strength. Not infrequently the patient survives the period of danger while the abscess is acute and passes into a stage of *chronic invalidism simulating tuberculosis*. The fever subsides, to recur at intervals, or remains in the neighborhood of 99° or 100° F. for weeks or months. At intervals frank febrile attacks occur, during which the patient returns to bed for a few weeks or longer. The cough becomes chronic and not infrequently paroxysmal, and varies from time to time in intensity, but seldom disappears. The expectoration continues in varying amounts and is usually offensive. Hemoptysis occurs and may prove fatal. The lesion is usually basal, but may occur at the top of the lung. The clinical picture is not unlike that of chronic pulmonary tuberculosis, but the sputum is repeatedly negative when examined for tubercle bacilli. A certain number of these victims have been sent to tuberculosis sanatoriums with a mistaken diagnosis.

This is the type of patient whose treatment I wish to discuss, namely, the patient with a localized acute or chronic lung suppuration without a pleural complication. When a pleural complication is present surgery must be resorted to. In the absence of a complication the most recent and valuable procedure which has been added to our therapeutic armamentarium is bronchoscopic drainage. The notes of one of our patients may be of interest at this point:

M. S., Dept. No. 6958, female, white, age twenty-seven,

stenographer, came under our observation in May, 1923. She gives a history of a gall-stone operation on September 14, 1922. During convalescence from the operation she developed a slight non-productive cough. This gradually became severe, and on October 28, 1922 a considerable quantity of foul-smelling sputum was expectorated during the course of twenty-four hours. The patient does not recall the exact amount, but the "sudden appearance of so much sputum" impressed her as unusual. For some days the foul expectoration continued, but in reduced quantities. On January 14, 1923, after a sudden attack of severe coughing, another large quantity of foul yellowish sputum was brought up. On January 24, 1923 there occurred a small pulmonary hemorrhage, which the attending physician noted as about 2 ounces in amount. Another attack characterized by a sudden intensification of the cough followed by the expectoration of a large quantity of foul blood-streaked sputum occurred in April, 1923. In the intervals of these three episodes of "severe cough and profuse expectoration" in October, January, and April there were minor exacerbations of the cough and expectoration. In the intervals she would feel that she was getting better. However, the general course was downward—fever seldom disappeared, the pulse rapidity increased, loss of weight and strength became progressive, and she was compelled to spend the greater part of the time in bed. The physician who referred her to us noted that on January 14th the signs in the chest were those of a lesion in the lower part of the right upper lobe. He also reported that repeated examinations of the sputum were negative for tubercle bacilli. The physician made the diagnosis of pulmonary abscess and sent her to us for bronchoscopic treatments.

Our studies confirmed the diagnosis. Many sputum studies were negative for tubercle bacilli. The *physical examination* of the chest revealed distinct limitation of expansion on the right side. On the same side percussion resonance was diminished from the second to the fourth rib anteriorly. Over this area the breath sounds were distinctly tubular. There were many fine crackling râles from the second rib to the base anteriorly.

and about the angle of scapula posteriorly. The left lung was clear throughout. The heart action was rapid and the sounds feeble, but no audible murmurs could be detected. The fingernails showed incurvation with slight clubbing. The x-ray study by Dr. Manges revealed the following: There is a lesion, probably an abscess, in the lower portion of the upper lobe on the right side at the level of the second and third interspaces. There is evidently a cavity about  $1\frac{1}{2}$  inches in diameter, but this does not drain an area which is considerably longer than the cavity itself. The lower border of this area seems to be limited by the interlobar pleura.

Bronchoscopic treatment was started on May 9, 1923. Dr. Lukens and Dr. Moore, who have been doing the bronchoscopic work so skilfully, made these notes of the first bronchoscopic examination: "Trachea curved to the right--general curve from larynx to corina about 2 cm. arc. Pus coming from right upper lobe bronchus and posterior branch of the right lower lobe bronchus. Spur to the right upper lobe bronchus thickened and inflamed. Rest of the bronchi, right and left sides, are normal. Diagnosis: Abscess, pulmonary, right upper lobe. The amount of pus coming from right upper lobe was very scanty. Specimen obtained for bacteriologic study."

Subsequent bronchoscopic treatments (aspiration and injection of gumenol) were repeated on May 16th, 23d, 30th, June 6th, 13th, 20th, 27th, July 11th, 18th, August 1st, 29th, September 12th, 26th, October 3d, 17th, 31st, November 14th, December 13th. During the week after the first bronchoscopy (May 9th) the patient noticed a distinct lessening in the cough and freedom from expectoration. She expressed gratification at the improvement and wished to continue. After the second bronchoscopy (May 16th) the expectoration returned for a few days, although the cough was not distressing. At the time of the third bronchoscopy (May 23d) the improvement in the cough and expectoration was marked, but a continuance of the bronchoscopic treatments seemed justifiable because pus was seen coming from the area. The signs in the chest, however, were very much the same as upon the first examination. This finding

is not unusual, however, since in many improving lung lesions the change in the signs is much slower than change in symptoms. It was not until the sixth bronchoscopy on June 13th (that is, five weeks after coming under observation) that no pus was found coming from the right upper lobe bronchus. Dr Lukens said that at this time the bronchus appeared normal. One week later (that is, June 20th), when I examined the patient, she stated that she was free from cough and expectoration. The chest continued to show some limitation of motion on the right side and some obscuring of the breath sounds over the old area, but no rales could be detected. Generally the patient was much improved. Her temperature had continued normal and she was gaining strength and weight. She returned to her work as a stenographer.

Thereafter the patient's progress was uneventful except for a short febrile episode in September, with a return of cough and "pus from right upper lobe bronchus." She has continued well and at work except for the few weeks' "lay off" in September.

As you see her today (December 19th) she looks well, feels well, and her chest is clear. The x ray made yesterday by Dr Manges shows the lung clear except for a narrow band, probably scar tissue, extending from the hilus to the chest wall. There is no exudate present and no evidence of the previously found cavity.

When we review the brilliant foreign body work of Chevalier Jackson, Louis H. Clerf, and Gabriel Tucker and note how well the lung suppuration has cleared up after the causative foreign body was removed by bronchoscopy and the establishment of adequate drainage, the conclusion is inevitable that a trial of the same procedure has a rational basis in those cases of lung suppuration not due to foreign body. Furthermore, the great value of the procedure is its safety in the hands of those skilled in its use. There is no mortality and no appreciable ill effects from bronchoscopy in suitable cases. It is not fair to expect the method to be of value in moribund patients, or those with wide spread suppuration or multiple abscess formation, or with complications, such as empyema, etc. On the other hand, to

witness the reduction in the amount and fetor of the sputum, the improvement in the cough, the improvement in the general condition as a result of the lessened toxemia in patients treated bronchoscopically, is to witness that which occurs less commonly with other present-day methods.

By bronchoscopy one is able to apply that oldest of all accepted principles in the treatment of abscess—drainage. Bronchoscopy facilitates drainage by allowing direct aspiration of infected material. Plugs of pus and débris which obstruct can be removed and stenosed air-passages can be dilated. Bronchoscopy is done without general anesthesia. There is a minimum of discomfort to the patient. Most of the patients in whom this treatment is continued to the point where they can leave the hospital, return at intervals. They walk into the hospital, get up on the bronchoscopic table after removing their collars, receive bronchoscopic treatment, get up, put on their collars, and go home. I have witnessed this every Wednesday for over a year. I can hardly reconcile my experience with that of Miller and Lambert, of New York, who state that in adults it is a trying ordeal for many patients. Miller and Lambert had 3 patients treated, one of whom died apparently from a rupture of the lung directly following treatment.

It should be emphasized that bronchoscopic drainage in lung suppuration supplements and does not replace those measures which have been found useful in the past. Postural drainage is of the utmost importance when properly carried out. The body is inverted over the side of the bed with head down on the floor, at first for a few minutes and later increased to ten or fifteen minutes a day. Postural drainage is helpful in aiding the natural drainage in the interval of the bronchoscopic treatments. This procedure, however, is not without discomfort to the patient, and several have told me that they much preferred the less discomfort of the bronchoscopy. In addition to the bronchoscopic drainage plus postural drainage, attention should be directed to the importance of those measures which tend to improve the general condition of the patient, rest in bed—absolute or partial—an abundance of fresh air,

nourishing diet, liquids freely, laxatives, autogenous vaccines, etc

Surgery should be resorted to with reluctance in patients with localized lung suppuration unless the abscess is quite near the chest wall, or there is a complicating empyema. The radical procedures of surgery are associated with a high operative mortality. Lockwood states that the literature contains reports of 1117 cases of lung abscess with an average mortality with surgical treatment of 34.6 per cent. Lilienthal, who may be regarded as having had an extensive experience with resection of the lung for abscess had a mortality of 54 per cent. In bronchiectasis Graham found among 48 reported cases submitted to lobectomy an operative mortality of 52 per cent. This does not mean that all of those who recovered from operation were cured, many of them no doubt were unimproved. Is it any wonder that we have been loath to refer patients for such a formidable operative procedure? Before the advent of bronchoscopy we who were conservative waited, hoping that drainage by way of the bronchial tubes would become established in due time, and when this occurred we endeavored to aid drainage by posture of patient. Some tried to help matters by inducing pneumothorax. Rich and others have reported favorable results. This method however, is not without danger and 2 deaths have been recorded by Wessler. Among 7 patients treated in this way by Miller, none improved and 2 died.

With the development of bronchoscopy as a safe procedure in skilled hands we have come to recognize in this clinic that for suitable and selected cases of lung suppuration it is a valuable adjunct in treatment. It will not help every case but in the hands of skilled men its safety commends it to trial.

## CLINIC OF DR HENRY K PANCOAST

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### THE X-RAY DIAGNOSIS OF SURGICAL CONDITIONS OF THE ESOPHAGUS

BEFORE taking up the various conditions for which the esophagus may be examined by x-ray methods it will be best to consider briefly the various procedures which are employed in carrying out x-ray investigations of this structure. The usual clinical methods of examination, as you know, are by means of the bougie and the esophagoscope. I think you will agree with me before we have concluded this talk that x-ray methods should always be employed first in any case in which a lesion of the esophagus is suspected. The following are the usual procedures employed in the x-ray studies of the esophagus, and consist essentially in the introduction or swallowing of opaque substances which will be visualized by the x-ray:

1. Swallowing of bismuth subcarbonate or barium sulphate suspended in water or buttermilk or some other vehicle.
2. The swallowing of a bolus of powdered subcarbonate of bismuth or batium sulphate mixed with jam or marmalade, making a semisolid food.
3. The swallowing of a capsule containing some of the opaque powder.

If we were restricted to any one of these methods alone I would certainly select the capsule. In all of our examinations of the esophagus we employ one or all of three different positions following a routine general fluoroscopic survey of the chest: First, the patient may be examined in the erect posture with the left shoulder-blade against the screen or plate, the rays being directed from the right side of the chest anteriorly; second,

the reverse of this position, third, with the patient lying obliquely prone on the horizontal fluoroscopic table, with the right side of the chest on the table and the screen or the plate placed against the left scapular region. The left knee is flexed up to the abdomen and both arms are placed over the head. The particular advantage of this position is that the act of swallowing is much slower and we are permitted thereby to view the passage of the opaque food through the esophagus with more ease. There is a slight upgrade to the esophagus in this position, the lower end of the tube being somewhat higher than the upper end. The patient takes the liquid food through a rubber tube from a glass or it may be fed with a spoon. It is possible to examine large sized strictures in this position to much better advantage than in the erect posture. Plate exposures may be hurriedly made in any of these positions at critical times when a record of the examination seems desirable.

There are three general conditions for which the esophagus is examined—obstructions, diverticula, and fistulæ. We will first take up the discussion of obstruction to the act of swallowing. The function of the esophagus is to carry the food from the mouth to the stomach. Anything which interferes with this function causes more or less obstruction. In a general way we may say that interference may be due to pressure from without, changes in the walls of the esophagus, foreign bodies, or reflex causes. Many of the conditions which come under these headings are not distinctly surgical ones, but the examiner must have in his mind all possible conditions which may cause obstruction when he is making an examination, and must also detect any conditions which may contraindicate esophagoscopic examinations or require that unusual care be exercised. The various causes whereby pressure from without the esophagus may produce obstruction are:

1 Aneurysm, usually of the arch of the aorta. It must be borne in mind that the aortic arch has a very close relation with the esophagus normally, and enlargement of the arch may cause some pressure upon this structure. As a matter of fact, even in the normal individual the esophagus will be found somewhat

narrowed where the arch of the aorta crosses over it. It is particularly desirable to detect the presence of aneurysm in cases in which there may be obstruction or foreign body in the esophagus. The esophagoscopist must know of the presence of aneurysm because of the danger of injuring the aorta during his manipulations.

2. Neoplasms in the neck, mediastinum, or in the lungs may press upon the esophagus and cause obstruction. It is important to determine whether these conditions are entirely responsible for the difficulty in swallowing or whether some foreign body may be present in addition.

3. Enlarged glands in the mediastinum may cause obstruction. Glands may cause pressure by their mass, or if they have previously broken down at some time, the resulting scar tissue may cause stenosis of the esophagus.

4. The presence of mediastinal abscess or spinal abscess.

5. A large dilated heart may sometimes cause some difficulty in swallowing.

We need not dwell further on any of these causes of obstruction, but I simply remind you that the detection of any one of them is of the utmost importance.

We will now consider the second group of conditions under the heading of changes in the esophageal wall.

1. Neoplasms are the most frequent and probably the most important of these. Obstruction caused by carcinoma of the esophagus may be due to the encroachment of the growth itself upon the lumen, the constriction due to the growth, local spasm due to the irritation caused by ulceration.

2. Benign ulceration with resulting spasmotic contraction.

3. Cicatrization from old ulcer, the usual cause of which is the swallowing of caustics. Ulceration may also occur as a sequela of certain diseases, as syphilis, typhoid fever, and tuberculosis.

4. Congenital stenosis or atresia.

**Carcinoma of the Esophagus.**—Any portion of the esophagus may be involved by this growth. We have found in our experience that the lower third of the esophagus is most commonly

involved, next, the upper third and the least frequently, the middle third. Although the treatment of carcinoma of the esophagus is rather unsatisfactory, it is highly important that an early diagnosis should be made, and undoubtedly the best means of diagnosing and studying this growth are the combination of x ray methods and the esophagoscope. It has been our custom for a number of years to examine the esophagus of each gastro intestinal case studied and we have occasionally detected an unsuspected lesion, but we have found by experience in a few instances that the usual routine examination carried out by the swallowing of a liquid suspension of barium or bis muth will not reveal all cases of carcinoma of the esophagus, especially an early stage before obstruction becomes the prominent feature. In this connection I would like to direct your attention particularly to the great importance of not overlooking the symptom of substernal pain. If no cause is found for this in the routine examination of the chest or spine it is very important that you always examine the esophagus and not only with the usual liquid suspension of opaque powder but also with the capsule. In a number of instances we have found obstruction in the esophagus by capsule that could not be detected in any other way. I would like to call your attention to one case of this kind in particular. The patient was a cook who had been in our family for seventeen years. For several weeks she had been complaining of pain under the lower part of the sternum and of indigestion. She was treated medically for some time but with no improvement the discomfort gradually becoming greater. I then made a gastro intestinal study that included the esophagus. Our esophageal examination was entirely negative. Some adhesions were found around the pylorus, partly constricting it, but not causing a six hour residue. The origin of these adhesions was ascribed to probable ulcer or gall bladder disease. The clinical diagnosis was probable carcinoma at the pylorus. She was operated upon the adhesions found and released, and the gall bladder and the appendix removed because both were regarded as diseased. While she was in the hospital at rest she was somewhat improved. After she

was taken home her old symptoms reappeared and she became worse than before her operation. We began to suspect the possibility of a carcinoma around the fundus of the stomach that had not been detected by the x-ray examination or at the time of operation. Six months later her symptoms were so pronounced that I again made an x-ray study of her esophagus, and found evidence of obstruction in the lower third, with the radiographic appearance of carcinoma (Fig. 8). This diagnosis was confirmed by the esophagoscope. We thus lost six months



Fig. 8.—Obstruction to opaque liquid suspension in lower thoracic esophagus due to carcinoma

in the possible treatment of this case from the time some obstruction should have been diagnosed, and when the true condition was determined it was too late to give any treatment. If at the time of her first examination she had been given a capsule to swallow we would undoubtedly have been led to suspect the condition by finding some obstruction that would have called for an esophagoscopic examination, and a correct diagnosis would have followed. This is a film of the patient's esophagus six months after the condition should have been diagnosed.

The radiographs of the second case I wish to show you will illustrate very well the value of the capsule in an early diagnosis of carcinoma of the esophagus when other methods failed. This patient, a male aged fifty four years, was referred to us for an examination of the esophagus because of dysphagia which had been present during the past seven or eight months. This was not the only condition from which the patient suffered, as he had been treated for other medical conditions including hemolytic jaundice for a considerable period of time, but dysphagia was one of the later manifestations. We made an x ray study



Fig 9.—Obstruction to opaque capsule in lower thoracic esophagus due to carcinoma. Liquid and semisolid foods not obstructed

of his esophagus October 9, 1923. We found that liquid suspension of bismuth and a semisolid mass of bismuth in jam passed through the entire esophagus with ease, and we had almost reached the conclusion that nothing was wrong with the esophagus when we decided to have the patient swallow a No 0 capsule containing bismuth subcarbonate. We found that it lodged for a very short time in the lower third of the esophagus, but was easily dislodged by water. We made a note of this in our report and considered it advisable to have an esophagoscopic examination made. This was not done at the time. A second x ray examination was made November 5, 1923, and still further

obstruction to the passage of the capsule was found at about the same point as at the previous examination. There was at this time very slight obstruction to semisolid and liquid food. Here is the film made with the capsule in position (Fig. 9). Following this examination the esophagoscope was used, and a carcinoma was found at the point of lodgment of the capsule and continued down the esophagus for about 5 cm. at least. This length of the involved esophagus could be explored, but no further, and possibly the growth extended still further down toward the stomach. Your attention is called particularly to the fact that the diagnosis was made by the *x-ray* of some obstruction at least one month before the esophagoscopic examination was made.

The question frequently arises as to which procedure it is better to practice first—swallowing of the capsule or of the liquid suspension. In some cases it is preferable to use the capsule first, while in others the liquid and semisolid foods are better. If we meet with an obstruction the capsule will plug up the caliber of the obstruction and the liquid suspension will then pile up above the capsule and outline the esophagus fairly well and much better than we can expect to do very frequently if the suspension alone is used, but we may be misled in our diagnosis. The decision must always be made upon the merits of the individual case.

To demonstrate to you the wisdom of making an *x-ray* examination first in cases of suspected esophageal obstruction I will show you the radiographs of a third case. This patient, a male aged fifty-three years, was referred to us for an examination of the chest November 23, 1922, with a history that three weeks before that time he developed pain in the left side of the chest, with cough and expectoration, which had been fetid for the past two weeks. He presented signs in the left chest of pleurisy and of a localized area in the left gutter of the spine, where there was bronchial breathing, impaired percussion note, and increased voice sounds. The clinical diagnosis was either localized empyema, lung abscess, or possible malignancy. An *x-ray* examination of the chest made at that time showed a lesion in

the left upper lobe which was regarded as inflammatory in nature and probably due to abscess with an accompanying localized collection of fluid in the axillary region (Fig 10). The patient was again referred to us five days later because on the previous day he began to regurgitate all liquids and solids swallowed. A stomach tube had been passed and met with an obstruction 31 cm below the incisor teeth. A neoplasm was now suspected or possibly an abscess of the esophagus with secondary lung abscess. The patient was examined in the esophageal position.



Fig. 10.—Abscess or inflammatory condition of left upper lobe due to perforation of esophagus from carcinomatous ulceration.

erect posture by giving him a liquid suspension of bismuth subcarbonate in buttermilk to drink. We were amazed to see the column not only stop in the midthoracic esophagus, but also to radiate thence through all parts of the chest. We knew at once that the patient had a ruptured esophagus and that the opaque food was escaping into the bronchial tree. This is very distinctly shown in the film (Fig. 11). Undoubtedly, this patient had a carcinoma as shown by autopsy ruptured by the passage of the stomach tube. His days would have been short.

anyway even without passage of the stomach-tube, but this case teaches us a lesson that it is unsafe to pass any object down the esophagus for diagnostic purposes until a careful x-ray study of the esophagus has been previously made.

STUDENT: Following out the suggestion previously made by you, would it not have been better to have given a capsule to this patient before giving him the liquid suspension of bismuth to swallow?



Fig 11.—Same case as Fig 10. Perforation of esophagus probably into trachea permitting leakage of opaque liquid suspension into bronchi and branches.

DR. PANCOAST: Your question has been asked at a very appropriate time. If we had given the capsule first in this case we might have plugged up the opening between the esophagus and the air-passages and we might not have found the bismuth escaping into the bronchial tree. On solution of the capsule some of the bismuth suspension would have eventually passed through the opening. It is usually better technic to employ the liquid suspension first.

STUDENT: What was the cause of the appearance in the left lung found at the first x-ray examination of the chest?

DR PANCOAST I have no doubt that the abscess in the lung was due to a slow leakage through a very small opening between the esophagus and the air passages. The passage of the stomach tube undoubtedly enlarged the opening so that a large amount of contents of the opaque suspension passed through. It was found by further questioning the patient before he died that he had had difficulty in swallowing for a long time but this point had not been brought out when the clinical history of the case was taken. All x ray findings were confirmed at autopsy and the suspected carcinoma was confirmed.

We will now consider the third group of causes of esophageal obstruction namely *the presence of foreign bodies*. Foreign bodies may lodge in any portion of the esophagus, but are most frequently found at about the level of the suprasternal notch. This is just above where the arch of the aorta crosses the esophagus and below the cricoid constriction, and, according to Dr Jackson, the lodgment of foreign bodies here is due to positive pressure within the chest. Because of the difference in methods of examination we divide foreign bodies lodged in the esophagus into two groups—those which are opaque to x rays and those which are not opaque.

The detection of opaque foreign bodies is comparatively easy. The fluoroscope alone should not be relied upon for their detection as one may easily overlook a small object, such as an ordinary pin or a piece of bone, which casts a definite shadow on the plate, but may not be seen by the fluoroscope. The examination must determine the exact location of the foreign body for purposes of removal, its close relation with other important viscera, particularly the arch of the aorta and the trachea, the direction in which the body lies, and the location and direction of sharp points of such bodies, as open safety pins, dental plates, ordinary pins, etc. Most foreign bodies which are wider in one dimension than the other will be found to lie transversely placed in the esophagus. This is a point of differentiation between foreign bodies in the trachea and the esophagus. In the trachea they are almost always found with the longest diameter in the anteroposterior direction. As an example of

the importance of determining the exact location and direction of sharp points, we will take the open safety-pin. Safety-pins are usually swallowed when open by children. They usually pass down hinge first, and must be removed in the opposite direction. It is always necessary to protect the esophageal wall from the point during removal, or perforation may occur. Sometimes the point is embedded and the head must be slightly depressed in order that the sharp point may be grasped by the forceps of the instrument for removal. It may be necessary to render fluoroscopic aid to the esophagoscopist when he is removing the foreign body. Usually in the removal of a single foreign body such aid is not necessary provided the roentgenologist has given the bronchoscopist the exact knowledge he desires. It is always extremely important to make a second x-ray examination of the case after removal of a foreign body, for the reason that a second one may still be present. This is especially the case when coins have been swallowed. One coin may lie directly in front of another and give the appearance of a single one, and if only one is removed, of course the other still will remain and will be detected by the subsequent routine examination.

Foreign bodies which are not opaque to x-ray will, of course, not cast any shadow, and their detection is impossible by direct x-ray evidence. There are four ways of determining the presence of a non-opaque foreign body:

1. It may obstruct the passage of opaque liquid or semisolid food

2. The behavior of the opaque food as it passes the body, that is, it may canalize one side or the other or back or front of the foreign body

3. Swallowing of opaque powder in capsule form may render the foreign body opaque after the capsule dissolves.

4. Swallowing of the capsule itself. In practically every instance the foreign body will obstruct the capsule. Even a small piece of fishbone sticking in the esophagus will stop the capsule in its downward descent (Fig. 12). Never consider your examination complete without giving the patient a capsule to

swallow. We have on a number of occasions found the capsule lodging somewhere in the esophagus after supposed swallowing of foreign bodies, and a very small object has been removed by the esophagoscope and forceps.

Quite frequently the obstructing foreign body will be a large bolus of food, such as a piece of meat or potato. If the body lodges in the cervical or upper thoracic portion of the esophagus it may be found that the esophagus encroaches more or less on



Fig. 12.—Obstruction to opaque capsule in upper thoracic esophagus due to lodgment of fish-bone. Liquids and semisolids passed the foreign body readily.

the trachea and obliterates the posterior part of the clear space of the trachea on the radiograph. This cannot, of course, be determined fluoroscopically. A foreign body the size of a piece of potato or a piece of meat causing complete obstruction will give an appearance closely resembling that of carcinoma when a liquid suspension is swallowed. As a matter of fact, even in cases of carcinomatous stricture of the esophagus the exact location of the stricture frequently cannot be determined roent-

genologically because of the presence of food which has been previously swallowed, and it may be necessary to wash out the esophagus above the stricture before exact determination of the upper margin of the latter can be found.

One must be very careful to differentiate between the presence of foreign bodies in the air-passages and the esophagus. Patients are quite frequently suspected of having opaque foreign bodies in the air-passages and particularly in the trachea because of certain respiratory phenomena. On a few occasions in such



Fig. 13.—Collar button in esophagus



Fig. 14.—Same case as Fig. 13  
Lateral view showing pressure en-  
croachment upon trachea and canali-  
zation of opaque liquid posterior to  
foreign body

cases we have found the foreign body to be in the esophagus and to have ulcerated through or nearly through into the trachea. To illustrate this point I will show you the radiographs of a child aged nine months, who was referred to us for an x-ray examination because a previous examination had shown the presence of a foreign body, a collar button, in the esophagus. There was no history of the child having swallowed this body. The symptoms were largely respiratory and a later broncho-scopy showed that the larynx and the trachea were

intensely inflammatory, that the posterior tracheal wall bulged forward, and was almost in contact with the anterior wall on inspiration. Our x-ray examination showed the presence of a "collar button" in the esophagus. This was determined by the anteroposterior and the lateral views (Figs. 13 and 14). You will note in the lateral view that the base of the collar button does project forward and seems to obliterate the lumen of the trachea. The child was given bismuth to swallow and this passed down posterior to the collar button. The lateral view shows, however, that the entire collar button is not in the trachea. We could not determine whether or not it had perforated through, but the bronchoscopic examination showed that it had not. The esophagus and posterior tracheal walls were thus obliterating the lumen of the trachea.

The fourth group of causes of obstruction to the act of swallowing comprises reflex disturbances, which may arise from new growths, ulceration and inflammatory lesions in the neighboring larynx or in the neck, ulcers and new growths at the cardiac end of the stomach, neurotic and hysterical individuals, bulbar paralysis and the very frequent condition known as phrenospasm. This is the only important one of this group that requires discussion from the standpoint of surgical relief or diagnosis. The obstruction in this condition is always found at the hiatus esophagi in the diaphragm. In extreme cases there is more or less dilatation above, and sometimes this is enormous. The appearance by the fluoroscopic screen and in the film of these cases is quite spectacular. The very large shadow of the esophagus will, of course, be readily seen, and it terminates rather abruptly at a point with fairly regular outline at the lower end. The characteristic feature of the constricted area is the very marked curve of the lower end of the esophagus to the left in the direction of the stomach. This is an important point in diagnosis. The second important point is the fact that if the patient be given a sufficient quantity of food to overfill the esophagus, the spasm will be more or less relaxed and the food will be seen to enter the stomach in spurts, and frequently in very large quantities whereas little or nothing

passes through the point of constriction or spasm before the esophagus is fairly well overloaded. One can readily see how futile it would be to attempt to pass a straight bougie through the point of constriction in a case of this kind. The bougie would strike the curving right border of the esophagus.

The films of a very interesting case of phrenospasm will serve to illustrate very well the various points to which your attention has been called and the fact that the esophagus should be examined in many of the obscure supposed mediastinal



Fig. 15.—Supposed mediastinal tumor on right side of chest, found later to be due to a dilated esophagus (phrenospasm) filled with food.

tumors, for it sometimes happens that supposed tumors are really dilated esophagi. The patient was a colored female, aged forty-four years, who was referred to us for an examination of the chest because of suspected infiltration of the right apex and a substernal mass. We made the usual routine examination of the chest, fluoroscopically and by films. The examination revealed what was supposed by us to be a large mediastinal tumor on the right side extending from the clavicle to the diaphragm. This examination was made September 14,

1922 (Fig. 15). She was again referred to us one week later because of some obstruction to swallowing. This was the first knowledge the clinician had of any symptoms of this kind. The patient was placed in the oblique position standing before the fluoroscopic screen and was given some liquid bismuth and buttermilk to drink. This apparently passed with ease through the esophagus. She was then given a No. 0 opaque capsule to swallow and it was found that this lodged just above the mid-



Fig. 16.—Same case as Fig. 15 one week later. Opaque capsule lodged in supposed diverticulum with lumen of esophagus containing liquid suspension apparently in front.

thoracic portion of the esophagus. She was again given some bismuth suspension to drink and it was found that the opaque column trickled down in front of the capsule. We made a diagnosis at that time of diverticulum of the midthoracic portion of the esophagus and we still had no idea that there was any connection between the esophageal condition and the supposed intrathoracic tumor (Fig. 16). The patient was again referred to us in April 1923 four months after the first examination and at this time with a clinical diagnosis based on the x ray

findings, probably, of diverticulum of the esophagus and mediastinal tumor. From our interest in the case we decided to make further studies of the esophagus, with practically the same results with the patient in the erect posture as at the first examination. At this time the patient could not swallow the capsule dry, and when she was given a swallow of water with it, the capsule passed slowly but steadily through the esophagus and apparently did not enter the supposed diverticulum. We



Fig. 17.—Same case as Figs. 15 and 16 four months later. Liquid opaque suspension now taken in sufficient quantity to show the lower end of the enormously dilated esophageal pouch in the erect oblique posture.

then placed the patient in the oblique prone posture and had her take the bismuth suspension through a rubber tube. We were very much surprised to see the opaque food fill up what appeared to be a very large diverticulum in the upper esophagus. We then again placed her in the erect posture and all of the opaque food was found to settle down to the lower part of the esophagus, and we then discovered, to our amazement, that we were dealing not with a mediastinal tumor, but with a case

of probable phrenospasm with an enormous dilatation of the esophagus above, and that the shadow of this was what led us to make a diagnosis in the first place of mediastinal tumor (Fig 17) It is interesting to note in this case that even when we had made the diagnosis, the bismuth liquid suspension still seemed to canalize down the anterior portion of the esophagus in the prone posture before it reached the settled portion of food at the bottom (Fig 18) We were never able to explain the



Fig 18—Same case as Figs 15-17 Note the filling of the enormously dilated esophageal pouch in the oblique prone posture, and also the continued tendency to canalize in the anterior portion

reason for this satisfactorily Sufficient opaque liquid had never been given in the erect posture previously to cast a sufficiently large shadow in the lower end of the pouch to be detected The enormous size of the esophagus is well indicated in the film made a week later than the last when we gave the patient to drink all the esophagus would hold At this point you will note that food is beginning to pass through the constriction at the hiatus and to descend into the stomach (Fig 19)

The second general group of esophageal conditions is di-

verticula. These may be either congenital or acquired. Congenital diverticula usually occur in the upper part of the esophagus near the level of the clavicle. They are small at first and grow larger later on, and eventually interfere with swallowing. Acquired diverticula may be due to various causes. Almost all of them occur in the upper portion of the esophagus. The great majority of diverticula are, therefore, found in the upper portion of the esophagus, and those in the lower portion are rather uncommon.



Fig 19—Same case as Figs 15-18. Note the tendency to leak through the lower constriction on complete filling of the esophageal pouch in the erect posture. The swallowed liquid still canalizes on the anterior aspect.

I will show you one case of congenital diverticulum which was found in the midthoracic esophagus. The patient was a female aged sixty-six years, who was referred for a gastrointestinal study, and the diverticulum was found by chance. It caused no obstruction to the passage of liquid food, but readily filled up on drinking liquid (Fig. 20).

The third general group of esophageal conditions, fistulae, has been referred to in connection with carcinoma.

In conclusion let us refer again to a few essential facts concerning esophageal examinations

1 The x ray study of the esophagus is a most important procedure in diagnosis and should precede the use of the esophagoscope and the bougie

2 It has greater value than any of the clinical methods of examination (except the esophagoscope) because it will usually show more to the examiner and is a much safer procedure



Fig. 20—Large congenital diverticulum from the midthoracic esophagus readily filling but not causing obstruction

3 The x ray examination must be carried out most carefully and by every method mentioned until the diagnosis is as well established as is possible

4 Do not consider a chest case diagnosed fully in which no cause has been found for substernal pain until you have made a careful study of the esophagus

5 In no case is an esophageal examination to be regarded as complete unless a capsule filled with bismuth will pass through readily without stoppage

## CLINIC OF DR. WILLIS F MANGES

JEFFERSON HOSPITAL

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### PEANUT KERNELS IN THE LUNGS. ROENTGEN-RAY DIAGNOSIS OF NON-OPAQUE FOREIGN BODIES IN THE AIR-PASSAGES

WE are here to consider a most important subject—the Roentgen-ray diagnosis and localization of foreign bodies in the air-passages of such consistency and density that they do not cast distinguishable shadows either on the fluoroscope or on the roentgenogram. It is an important subject because the ray diagnosis and localization is not only possible, but is, indeed, a very practicable and reliable procedure if one knows what to look for and how to make the study. I say this with firm conviction after having studied 100 or more cases from Dr. Jackson's Bronchoscopic Clinic here at the Jefferson Hospital in the last seven years

As a matter of fact, there has been but one proved foreign body below the level of the bifurcation of the trachea that has not given positive ray signs. This was a canna seed, a very smooth, hard, polished surfaced, non-irritating object, so that the usual pathologic changes had not taken place prior to removal. On the other hand, signs similar to those I will describe have been present in only a few cases that were not bronchoscopically verified by Dr. Jackson or his associate bronchoscopists, as foreign body cases; and even in those few exceptional cases there was ray evidence as to the cause, or the bronchoscopic findings were such as to warrant the deduction that an organic foreign body had been present and probably escaped spontaneously.

In a number of instances the diagnosis and localization of foreign body not itself showing in the ray was made in the ab-

sence of history of aspiration; yet my Roentgen-ray diagnosis was verified by the bronchoscopic removal of the non-opaque foreign body. On the negative side I recall a case in which there was a positive history of aspiration; but the ray signs were those of croupous pneumonia and not of foreign body. The middle right lobe was involved first, and about the time it underwent resolution the lower lobe became consolidated. The child made an uneventful recovery from the pneumonia and was sent home without a bronchoscopic study.

In September, 1921 I presented a paper on this subject at the American Roentgen Ray Society, and made an analysis of 56 cases. You will find this in the May, 1922, number of the American Journal of Roentgenology.

The foreign bodies of this type are almost entirely organic in nature. The most common one is the peanut kernel. Nuts of all kinds, seeds, pieces of apple stem, beans, fragments of corn-stalk, etc., are to be found at the Bronchoscopic Clinic in the collection of trophies.

Dr. Jackson has described the pathology, as well as the clinical features, physical signs, and diagnoses of such cases by means other than the *x*-rays. He has called the condition *arachidic bronchitis*. I am not prepared to discuss the physical signs or clinical features of this disease, but want to assure you that a negative diagnosis based on such signs and symptoms is by no means an easy or safe procedure except for the most expert clinician who has had an opportunity to study a large number of such patients.

All of you should read every bit of literature that has been written about such foreign bodies because there is no disease more certain to cause death, sooner or later, if the foreign body be not removed, and, perhaps, none more easily overlooked by those who have not studied the subject.

Now, the ray signs depend not upon a shadow cast by the foreign body itself, but upon some change in the mechanics of the air-passages that is brought about by the foreign body plus the pathologic changes in the immediate vicinity of the foreign body and in the bronchial distribution distal to the

foreign body. There is, first, some degree of obstruction; second, more or less accumulation of exudate; third, changes incident to infection; fourth, displacement and malfunction of the viscera, due to change in shape, size, and function of the affected lung.

In the vast majority of the cases the obstruction caused by the foreign body, together with the edematous inflammation surrounding it, affects expiration more than inspiration, that is, the air enters more easily than it escapes, and the affected lung or part of lung naturally is constantly overdistended with air; in other words, in a state of obstructive emphysema.

Obstructive emphysema must always be differentiated from compensatory emphysema. In the former the lung remains distended with air throughout the respiratory cycle, whereas, in the latter, the lung may be fully distended at the end of full inspiration, but it expels a great deal of its air during expiration. If the obstruction of the bronchus or some branch of the bronchus becomes complete, so that air neither enters nor escapes, then the air already in the lung becomes absorbed and the lung collapses and there is atelectasis. This may involve a portion of a lobe, one or more lobes, or even an entire lung. There is only one condition which might be mistaken for atelectasis, and that is an old chronic pleuritis with marked pleural thickening, associated with fibrosis of a portion of the lung and contraction. This point, of course, may be readily determined by looking into the previous history.

Exudate from the edematous inflammatory process may collect distal to the foreign body and even fill the parenchymal portion of the lung supplied by the bronchus involved. Dr. George C. Johnston has described this condition as "drowned lung." The shadow is only fairly dense and one can see the detail in the shadows of the bronchial branches through the shadow of the exudate. The involved area takes on a conical shape, with the apex of the cone at the foreign body. There is usually a moderate degree of atelectasis associated with this condition known as "drowned lung."

Infection caused by the presence of a foreign body gives

the same sort of appearance as lung abscess from any other cause. Depending upon the stage of development and the size

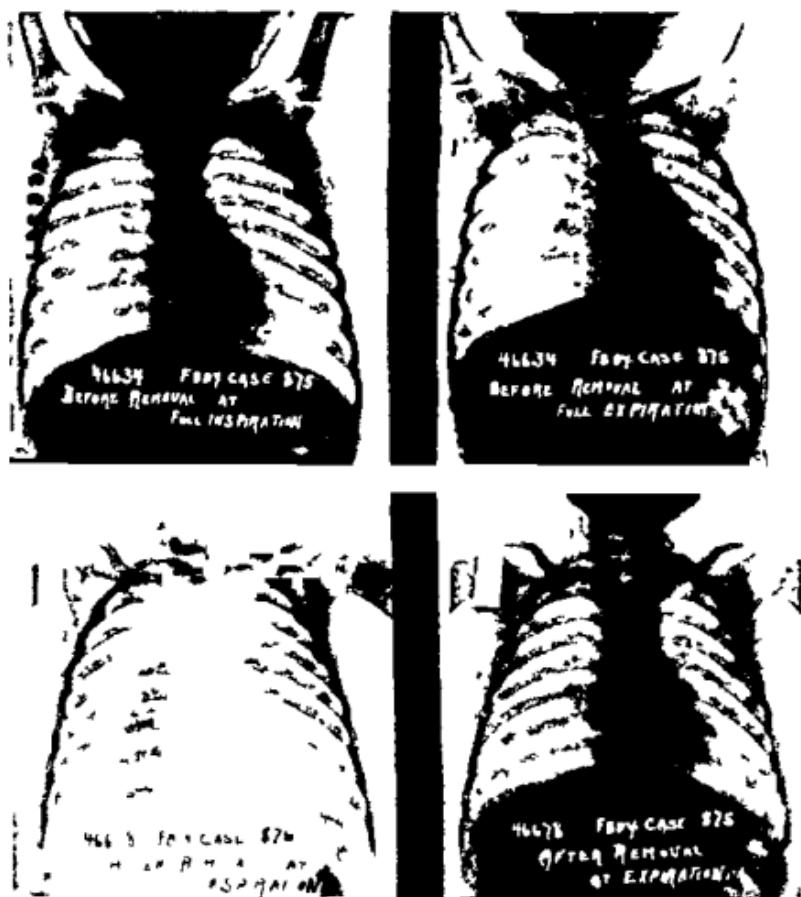


Fig. 21.—*a*, Both lungs contain a large amount of air at full inspiration. Right diaphragm is flattened, due to overdistention of right lung. Heart is displaced slightly to the left. *b*, At the end of expiration the left lung has emptied much of its air. The right lung remains overdistended with air because the peanut kernel, together with the edematous inflammation in the right bronchus is producing practically complete obstruction to expiration. The right diaphragm is still more flattened and the heart is displaced far to the left, and the left diaphragm is very much higher than the right. These changes take place with each respiratory cycle. *c*, Normal conditions and relations at inspiration after removal of foreign body. *d*, Normal conditions and relations at expiration after removal of foreign body.

of the area, the density of the shadows varies, as well as the shape of the consolidated area. But the density of a well-es-

tablished abscess is far greater than that of "drowned lung." One does not see the bronchial detail and, instead of being conical, the lesion is apt to be more rounded and have a very irregular border, and sooner or later cavities may be seen.

Displacement and malfunction occur to some extent in all of these conditions. When *obstructive emphysema* exists the heart and other mediastinal structures are displaced to the unaffected side and the diaphragm on the affected side is displaced downward. These signs are especially apparent at the end of expiration when the unaffected lung has emptied much of its air. There is considerable variation in these displacements. In some cases the heart and mediastinal structures move far to one side and the diaphragm may show comparatively little change, whereas in other cases the displacement of the diaphragm is noted without much displacement of the mediastinal organs, but in extreme cases both the mediastinal structures and the diaphragm may show quite marked displacement at the end of expiration. In making roentgenographic exposures of such conditions one should make an exposure at full inspiration and another exposure at the end of expiration. This requires quite a bit of knack at times because the children are usually quite young and apprehensive, as well as hungry for air. You cannot tell them to take a full breath and hold it, or expel air and stop, but you must watch the breathing motion and make an exceedingly short exposure by means of a time switch just at the proper fraction of a second. If there is any doubt in your mind as to whether the exposures were made at exactly the proper moment, they should be repeated, and the films should be marked in such a way that you can afterward tell which was made at inspiration and which at expiration. At the fluoroscope, as you will see, the lateral motion of the heart and aorta, synchronous with the breathing cycle, is quite striking, and when this is readily apparent at the fluoroscope, the diagnosis is positive, whether you succeed in getting satisfactory films or not. You will notice, too, that even though the two halves of the diaphragm may have normal relation with each other at the end of inspiration, the diaphragm on the

affected side will have a diminished excursion. When the expiratory obstruction is marked the affected half of the diaphragm may be even lower at expiration than at inspiration, due to the rather powerful contraction of the intercostal muscles in their effort to expel the air. There have been a few cases when the signs of obstructive emphysema were so slight that we were unwilling to make a positive diagnosis, but in such a case the emergency is not necessarily great at the time and the examination should be repeated on subsequent days when sooner or later the evidence is sufficiently strong to warrant either a positive or negative opinion. Obstructive emphysema will develop very soon after the impaction of a foreign body in a bronchus, not only because it is usually of such size and shape as to obstruct a considerable portion of the lumen of the bronchus, but also because it very quickly produces the edematous process above mentioned. I have seen very positive evidence of it within a few hours after aspiration, and I have seen the most positive evidence of it many days after aspiration. My belief is that it will remain positive until the portion of the lung distal to the foreign body either becomes filled with exudate or infection sets in and obliterates that portion of the lung.

*Peanut Kernel in the Trachea*—Now if the foreign body is in the trachea instead of in a bronchus the situation changes somewhat. If the foreign body is large enough so that its size, together with the edematous process in the mucous membrane obliterates a very considerable portion of the lumen of the trachea, then both lungs will show evidence of obstructive emphysema. We have seen a few cases of this kind and they usually present a most urgent appearance of air hunger. The diaphragm on both sides is always lower at expiration than at inspiration. The heart assumes a very much more median or rather vertical position at expiration than at inspiration. In other words, it rotates rather than moves from side to side. However, if the foreign body in the trachea is of such shape or size that it does not obstruct a large portion of the lumen, then there are no dependable x-ray signs. The watermelon seed is a fairly common tracheal foreign body. It can pass fairly



Fig. 22.—Atelectasis of right lower lobe. Foreign body produces complete obstruction of right lower lobe bronchus to inspiration. Air beyond foreign body has been absorbed.

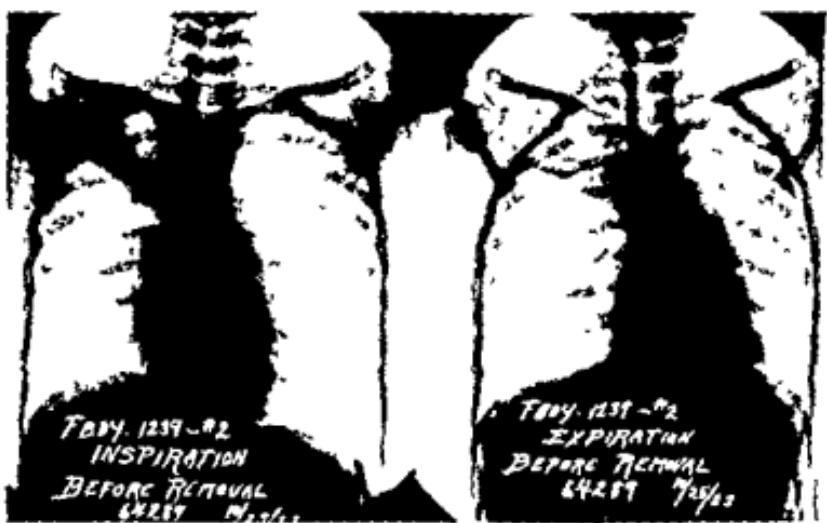


Fig. 23.—Three days later than Fig. 22. The foreign body has moved from the right lower lobe bronchus to the right upper lobe bronchus sufficiently to produce inspiratory obstruction, and projects far enough into the stem bronchus to produce expiratory obstruction of the lower and middle lobes. a, At inspiration compensatory distention of left lung. b, At expiration left lung empties, while right lower and middle lobes are overdistended because of obstructive emphysema.

right upper lobe with obstructive emphysema of the middle and lower lobes. This was due to a prune stone which, at the



Fig 24—After removal of foreign body conditions and relations have returned to normal



Fig 25—*a*, Almost complete atelectasis of entire right lung due to inspiratory obstruction of right main bronchus by a bean Note extreme displacement of heart *b*, In less than twelve hours after removal right lung has again expanded to almost normal

time of the first study, was tightly impacted in the lower lobe bronchus, but got loose from there, and on its way up turned into the upper lobe bronchus, completely obstructing it and at the same time producing expiratory obstruction of the lower

and middle lobes Dr. Clerf, at bronchoscopy, found the prune stone partly in the main bronchus and partly in the right upper lobe bronchus, and removed it from this location.

**Case I.**—I will not discuss further the matter of "drowned lung" nor of abscess formation, but would like to demonstrate to you at the fluoroscope a case of obstructive emphysema due to a peanut kernel in the right main bronchus. This little boy is unusually intelligent and very willingly helps me to make the examination satisfactorily. He will take a full breath and hold it when I ask him, and then exhale and stop, so that you will clearly see the two extremes of respiration. During quiet breathing you will notice that the left diaphragm moves very much more freely than the right, and that the right diaphragm is somewhat flattened and a little lower than normal. You will notice also that the heart is displaced to the left throughout the normal respiratory cycle, but the striking thing about it is the moving from side to side of the heart as he breathes. You will notice that the heart goes to the left at expiration. What little motion there is in the right diaphragm is due to a slight amount of air that leaves the right lung and also to the change in shape of the right lung as the left lung empties its air.

Now I will ask the young man to take a full breath and hold it. You see that the left diaphragm descends to a level a little below the right, and the heart is in very nearly normal position with relation to the median line and the diaphragm. This means, of course, that the left lung permits of intentional overdistention

Now I will ask him to blow his breath out as much as he can and stop. You see that the heart goes way over into the left chest and the left diaphragm comes up very much higher than the right, showing that the air content of the left lung is very greatly diminished. You will notice also the remarkable change in density of the left lung, whereas the right remains constantly illuminated. You will notice that the shadows of the structures around the roots of the lung are in every respect normal. There is no evidence of enlarged glands nor of any other mass pro-

ducing pressure from without on the right bronchus. It is true that there is a history here of aspiration of a peanut kernel, but even if I had not had a history in this case I would be just as positive of a foreign body of this nature in the right bronchus as if it were of metallic density and cast a positive shadow of itself.

I trust that I have made clear a few of these points with regard to the x ray signs of non opaque foreign bodies in the air passages. I would especially like you to understand clearly the signs that are present when the foreign body produces obstructive emphysema, on the one hand or atelectasis on the other hand.

and middle lobes. Dr. Clerf, at bronchoscopy, found the prune stone partly in the main bronchus and partly in the right upper lobe bronchus, and removed it from this location.

**Case I.**—I will not discuss further the matter of "drowned lung" nor of abscess formation, but would like to demonstrate to you at the fluoroscope a case of obstructive emphysema due to a peanut kernel in the right main bronchus. This little boy is unusually intelligent and very willingly helps me to make the examination satisfactorily. He will take a full breath and hold it when I ask him, and then exhale and stop, so that you will clearly see the two extremes of respiration. During quiet breathing you will notice that the left diaphragm moves very much more freely than the right, and that the right diaphragm is somewhat flattened and a little lower than normal. You will notice also that the heart is displaced to the left throughout the normal respiratory cycle, but the striking thing about it is the moving from side to side of the heart as he breathes. You will notice that the heart goes to the left at expiration. What little motion there is in the right diaphragm is due to a slight amount of air that leaves the right lung and also to the change in shape of the right lung as the left lung empties its air.

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Now I will ask him to blow his breath out as much as he can and stop. You see that the heart goes way over into the left chest and the left diaphragm comes up very much higher than the right, showing that the air content of the left lung is very *greatly diminished*. You will notice also the remarkable change in density of the left lung, whereas the right remains constantly illuminated. You will notice that the shadows of the structures around the roots of the lung are in every respect normal. There is no evidence of enlarged glands nor of any other mass pro-



Fig 26.—At A is seen a characteristic streptococcal tonsillar infection. The inflammatory zone on the anterior pillar is narrow and sharply limited at its outer margin. In such cases a cure of arthritic neuritis and other remote manifestations of focal infection may be expected. At C is shown an inflammatory zone on the anterior pillars that is not streptococcal. In such cases no improvement of remote manifestations of a focal infection need be expected from tonsillectomy because the culpable focus is somewhere else. At B and D are shown the respective cases (A and C) after tonsillectomy. (Color drawing by Chevalier Jackson to illustrate Dr H. H. Lott's clinical demonstration on tonsillar focal infections.)



zone that fades off gradually into the velar mucosa with no perceptibly defined border. This is, in my experience, diagnostic of a tonsillar infective focus in which streptococci do not predominate and in which a cure of the remote pathology, such as arthritis, neuritis, and the like, is not to be expected, even though tonsillectomy may be indicated for purely local reasons. In this non-streptococcal type of tonsillar focus the predominant organisms are often staphylococci. Sometimes they are other pyogenic organisms, but not streptococci.

In the particular cases shown in the sketch I showed the patients to Dr. Jackson on the basis of my clinical diagnosis as to the organisms present. I removed the tonsils and sent them to the laboratory, where my clinical diagnosis was confirmed. The after-results in the respective cases are shown at B and C. These are not rare and isolated instances, but were selected as illustrative of an important diagnostic point in daily use at our clinic.

Now let us look at 2 patients, one of whom showed the pillar zone characteristic of a tonsillar focal infection predominantly streptococcal, whereas the other showed the pillar zone characteristic of an infection predominantly staphylococcal.

**Case I.**—This patient, a man aged forty-six years, came into the clinic fourteen months ago. He had had sciatica which crippled him more or less for the previous three and a half years. He had been thoroughly searched for a seat of focal infection, and for exclusion had had four teeth extracted. He stated that he had never had quinsy or any kind of sore throat.

The tonsils were small and not grossly abnormal. Some crypts were abnormal, but there was no sign of pus or of exudate on the surface and nothing could be expressed. There was a narrow and dark band of inflammation along the margin of the anterior pillar on both sides. The edges of this inflammatory zone were sharply defined. The zone did not fade off into the surrounding mucosa, but stopped sharply and clearly, almost as if one had drawn a line with a tiny brush. This zone I regarded as absolutely diagnostic of a streptococcal infection. We there-

fore advised the removal of the tonsils, with the utmost confidence that we would thus remove the seat of focal infection, and with the expectation of curing the patient of his sciatica.

The patient consented, and we removed his tonsils completely with capsule intact. His tonsils were sent to the laboratory and the culture showed streptococcic growth. Symptomatic improvement began at once and in one month the patient was almost well. Today, fourteen months after the double tonsillectomy, the patient is still entirely free from sciatic pain, from which he had been a sufferer for three and a half years prior to our tonsillectomy.

**Case II.**—This patient, aged forty-nine years, suffering for six months from arthritis in both knees, wrists, and elbows, was referred to us by the Medical Department for examination to see if we could find a seat of focal infection in the nose or throat.

We found the tonsils cryptic, of medium size, and apparently of normal appearance. No cryptic accumulations were visible and, on pressure, none was expressed.

There was, however, a band of inflammation along both anterior pillars. This inflammatory band indicated a chronic tonsillitis under the cover of the pillar. But we noted something further. The band was quite different from that noted in the previous case. In the present case it was relatively pale, broad, and it faded out into the surrounding mucosa. This pale, broad, and fading zone I have found to be diagnostic of infections in which streptococci do not predominate. We believe the bacteria causing arthritis to be streptococci, therefore we did not advise the removal of these tonsils with any hope of curing the patient of arthritis.

The tonsils were manifestly diseased and removal was advisable for local reasons. After they were removed they were sent to the laboratory for examination. Cultures showed predominance of staphylococci, confirming our clinical diagnosis. The patient did not improve, which coincided with our expectations.

Later the focal infection responsible for the arthritic con-

dition was found in the teeth and after proper attention to the dental focus improvement followed.

In presenting this matter to your attention I have selected 2 typical cases for illustration I hope, however, that you will not look upon them as rare or curious instances The diagnostic point of the form and color of the inflammatory pillar zone, and its bearing on prognosis and surgical results have been abundantly proved by many cases My associates and I find these observations of the utmost usefulness in our daily work at the clinic, since my original investigations, the results of which were published in the Atlantic Medical Journal, November, 1923.

## CLINIC OF DR. ROBERT M. LUKENS

DEPARTMENT OF DISEASES OF THE CHEST, JEFFERSON HOSPITAL

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### PULMONARY ABSCESS FOLLOWING TONSILLECTOMY. A CURE BY BRONCHOSCOPIC DRAINAGE

THIS afternoon I wish to present a patient who came to us four months ago complaining of symptoms suggestive of pulmonary abscess. She was sent by Dr. F. R. Wheelock, of Scranton, Pa., with a view to the bronchoscopic drainage of the abscessed area.

**History.**—The patient is a woman twenty-three years of age. Her chief symptoms were pain in the right chest, cough with foul-smelling purulent expectoration, fever, night-sweats, hemoptysis, and loss of weight and strength.

There was nothing of note in the family history or in the personal history except an acute attack of appendicitis several years ago, which was not interfered with surgically, and a tonsillectomy under ether anesthesia six weeks prior to her coming to the clinic.

**Present Illness.**—Her illness dated from the day following the tonsillectomy, and began with fever and cough with a slight amount of expectoration. There was no blood in the sputum at that time. When she came to us, six weeks later, the expectoration averaged a pint in twenty-four hours, had a foul odor, and was at times blood streaked. She had lost considerable weight and had grown weak. Fever and night-sweats had occurred during her illness.

About a week before we saw her there had been a marked improvement, cough and expectoration had lessened, the temperature had been lower, and the appetite had been better.

Three Roentgen-ray examinations by Dr. Byron, of Scranton, Pa., showed a developing abscess of the right lower lobe. The patient had been continuously under rest treatment.

**Physical Examination.**—On admission to the Department for Diseases of the Chest of the Jefferson Hospital, physical examination by Dr. E. H. Funk revealed limitation of motion on the right side of the chest, especially in the lower half. Dulness in



Fig. 27.—Roentgenogram of patient showing abscess in the right lower lobe, indicated by arrows. (Film by Dr. Willis F. Manges.)

the upper and lower right axilla continuing posteriorly to the scapular line between the fourth and seventh ribs. Over this area breath sounds were greatly reduced in intensity and one hears an occasional crackling râle. Whispered voice sounds were heard more distinctly over this area than over the corresponding area on the other side.

**Diagnosis by Dr. Funk.**—“Infiltration and consolidation of the axillary portion of the right lower lobe. Perhaps slight in-

vovement of portion of the right middle lobe, though I rather think that the right middle lobe is clear."

The Roentgen-ray examination by Dr. W. F. Manges revealed an area of consolidation in the right lower lobe and possibly in the middle lobe. Dr. Manges believed that there was a pulmonary abscess, although there was no evidence of cavity formation. It was in contact with the chest wall probably in the axillary line, and not extending to the hilus.



Fig. 28.—Roentgenogram of same patient after cure showing only slight peri-bronchial thickening (Film by Dr. Willis F. Manges)

**Diagnostic Bronchoscopy.**—Four months ago we made a bronchoscopic examination for diagnosis, and especially to discover the path of drainage of the suppurative area in the lung. We also wished to verify the clinical and x-ray diagnosis of lung abscess of the right lower lobe and to decide the question as to involvement of the right middle lobe.

Passing the bronchoscope down the trachea, rather thick

pus was seen adhering to the tracheal mucosa, the breath was exceedingly foul. The pus was traced down to the right stem bronchus the left being clear of pus. Following the pus stream downward, the upper lobe bronchus was seen to be clear. The middle lobe bronchus was also clear and showed no evidence of draining a suppurative area. Still further tracking the pus stream its source was found at an upper and external branch of the right lower lobe bronchus. All the other branches of the lower lobe bronchus remained clear after removal of the overflow pus by suction. The pus coming from this bronchus was extremely foul in odor and of a light brown color with a creamy consistency.



Fig. 29.—Bronchoscopic sketch of the right stem bronchus showing the orifices of the upper (right of sketch) middle (top of sketch) inferior (left of sketch) lobe bronchi. Pus is shown issuing from the posterior external branch of the lower lobe bronchus.

**Bronchoscopic Collection of Specimen of Pus**—A specimen of pus was collected from the bronchus by draining the abscess into a sterile collector by suction. The collector was sealed and sent to the laboratory for a bacteriologic examination and the preparation of a vaccine. As much pus as possible was removed by suction and 5 c.c. of a 20 per cent solution of gomenol in mineral oil was instilled into the draining bronchus.

**Bronchoscopic Diagnosis**—Pulmonary abscess of the right lower lobe drained by an upper and external branch bronchus.

**Laboratory Report of Pus**—Specimen of pus submitted for examination was sterile and no vaccine could be made.

**Comment**—No anaerobic cultures were made. We think such cultures should be made in all cases when aerobic cultures show no growth inasmuch as we have found that several sub-

sequent "sterile" samples of pus from lung abscess gave rather abundant growths under anaerobic conditions.

Four bronchoscopic aspirations were done at weekly intervals. At each of these bronchoscopies the suppurative area was drained by suction and 5 c.c. of a 20 per cent. solution of gomenol in mineral oil were instilled into the bronchus draining the abscess.

At the third bronchoscopy (two weeks after the first bronchoscopy) no odor was detected on the patient's breath or in the air expired through the bronchoscope from the abscessed area.

**Second Physical Examination.**—Before being bronchoscoped the fifth time (one month after the first bronchoscopy) Dr. E H Funk reported that the patient had gained 2 pounds in weight during the previous week and in general appearance seemed well. She continued to cough, however, and raised several ounces of pus a day, most of which was thin and whitish. The signs in her chest had decreased to the point where he found it difficult to localize any lesion at all by physical signs. He advised a Roentgen-ray examination. Her weight was  $118\frac{1}{4}$  pounds.

The bronchoscopic examination done the same day revealed that there was no pus coming from any of the bronchi, and that there was no inflammation of the bronchial mucosa. The patient was advised to skip the next bronchoscopy, and after an interval of two weeks the bronchoscopic examination was again negative. She had gained 5 pounds in weight in the previous two weeks.

**Third Physical Examination by Dr. Funk.**—The patient has gained 29 pounds in weight since the first bronchoscopy and has had no cough or expectoration in the past month. Examination of the chest reveals no abnormal signs.

**Roentgen-ray Examinations.**—At the time of the last above-mentioned physical examination Dr. Manges reported that there remained in the abscessed area only a faint cloudiness, and that there was no evidence of consolidation and only a very little exudate present. He reported on the Roentgen-ray examina-

tion made two months later that by comparison with the former films there was continued marked improvement. There remained only slight peribronchial thickening and slight adhesions to the right diaphragm. He did not see a cavity or even any definite evidence of dilated bronchi.

**Final Bronchoscopy.**—The last bronchoscopy, made four months after the first bronchoscopy showed the tracheobronchial tree and its secretions to be perfectly normal.

The *interesting points* in this case are these. The short interval of time between the tonsillectomy and the onset of the pulmonary symptoms suggests an embolic origin, but blood streaked sputum one of the cardinal signs of pulmonary embolism, was absent until late in the disease and hence had no significance in the etiology. Another point, which we believe was against an embolic origin of the abscess in this case, is the slight amount of destruction of tissue as evidenced by the x-ray examinations and the rapid clearing up of the lesion.

Both the physical examination and the Roentgen ray revealed definite evidence of disease in the right lower lobe, but there was a question as to whether or not there existed any involvement of the middle lobe. Both Dr Funk and Dr Manges were of the opinion that the middle lobe was clear. Bronchoscopy definitely decided this point by showing that there was no pus coming from the middle lobe bronchus. Pus was suctioned from an upper and outer branch of the right lower lobe bronchus, which verified the physical finding of signs in the axillary region extending posteriorly to the scapular region.

The laboratory finding that the pus obtained from this case was sterile was incomplete as no anaerobic cultures had been made. In similar subsequent cases supposed sterile cultures gave rather abundant growth under anaerobic methods.

Treatment consisted in dietetic regulation, abundant rest, postural measures and bronchoscopic drainage. No vaccine was used because of inability to obtain a culture.

The bronchoscopic treatment was simply removal of pus by suction and the injection of 5-c.c. doses of a 20 per cent solution of gomenol in mineral oil into the abscessed area.

ous for endoscopes no matter what precautions are taken. In

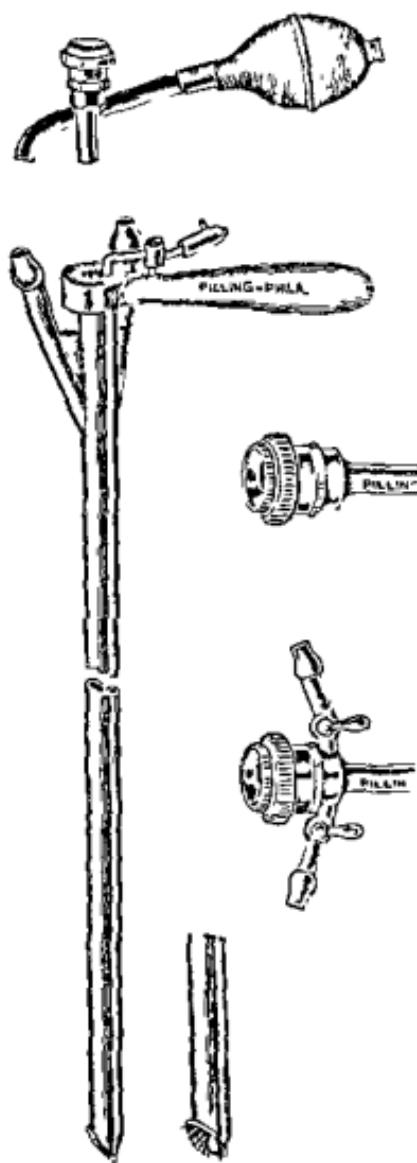


Fig. 30.—Chevalier Jackson's retrograde esophagoscope, gastroscope, pyloroscope, and endoscope for the retrograde study and treatment of lesions of the stomach, pylorus, duodenum, and esophagus in cases of esophageal stenosis. Used also to make a lumen and pass upward a string in cases of total atresia of the esophagus. Interchangeable window plugs of glass and with rubber diaphragm are for use when inflation is required.

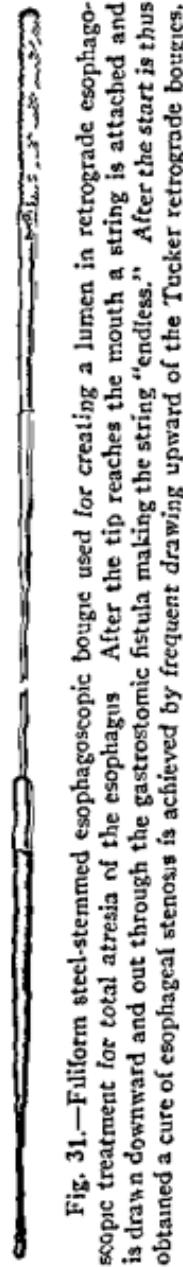


Fig. 31.—Steel-stemmed esophagoscopic bougie used for creating a lumen in retrograde esophagoscopic treatment for total atresia of the esophagus. After the tip reaches the mouth a string is attached and is drawn downward and out through the gastrostomie fistula making the string "endless." After the start is thus obtained a cure of esophageal stenosis is achieved by frequent drawing upward of the Tucker retrograde bougies.

addition to the gastroscope an independent aspirating tube, four sponge carriers, a plain forceps, and a specimen forceps

are needed. If bouginage of the esophagus is contemplated a small sized Jackson steel stemmed bougie (Fig 31) and a set of Tucker retrograde bougies are necessary. All instruments are sterilized and a sterile technic is carried out.

Preparation of the patient consists in having the stomach clear of food. Feeding is withheld for six hours prior to examination, and lavage of the stomach is usually carried out before the retrograde esophagoscope is introduced. The aspirating canal in the instrument and the velvet eyed aspirating tube will remove any remaining fluids.

Anesthesia, either general or local is not required in any case. The procedure is ordinarily not painful though a fistula at a bad angle may require a slightly painful degree of displacement.

As to position of patient, dorsal recumbency is best for the examination. Placing a small sand pillow under the back just below the angle of the scapula will lift the spine, so that the hiatus is more easily accessible. If it is desired to explore the upper esophagus, provision should be made for the patient's head and shoulders to project over the break in the table from the middle of the scapula upward. Crural tension is avoided.

The technic of retrograde esophagoscopy is simple in theory but is not so easy as might be supposed. To explore the cardia and abdominal esophagus the tube is introduced in a nearly vertical position until the posterior wall of the stomach is encountered. The tip is then carried upward and toward the patient's left until it is on a level with the costal margin. It is then directed toward the spine, which, however, is not crossed and the posterior wall is followed upward. In some instances this upward movement is guided by the spine. This technic avoids the lesser curvature and goes directly into the abdominal esophagus. Gentle pressure in this direction will usually find the hiatus (Fig 32), the tip of the instrument at all times being guided by sight, and all abnormalities noted. The disappearance of the rugae of the stomach mucosa and their replacement in the visual field by the pale, smooth, esophageal mucosa indicates the entrance into the esophagus. The patient will usually be

come nauseated and will attempt to vomit as the tube slips into the esophagus. The tube will pass without resistance into the middle third of the esophagus. Passage upward through the thoracic esophagus requires that the patient's position be now modified as mentioned a few minutes ago so as to get the low-head-and-shoulder position with the edge of the table in the



Fig. 32.—Gastrostomie pyloroscopy and duodenoscopy.

middle of the scapula (Fig. 32). In this way the upper dorsal spine is straightened on the lower. As the tube passes over the cricopharyngeal fold into the pharynx the head is gradually lowered until it is below the level of the table and the cervical spine is straightened on the upper dorsal, in reality, giving the low stage of Jackson's high low position for esophagoscopy.

If the patient is able to swallow liquids the examination of the cardia and esophagus is very greatly facilitated by having him swallow 2 yards of number "A" buttonhole twist silk, keeping the upper end of the string out through the mouth, or if a child, through the nose. The lower end is brought out through the gastrostomie fistula and threaded through the lumen of the esophagoscope. Following the string guide will quickly lead to the hiatus. If there is a severe ulceration or extensive infiltration in the region of the hiatus the string makes it very much easier to determine the hatal opening and very much safer to explore the ulcerated area.

**Gastrostomie Gastroscoopy**—All parts of the stomach are explorable by the retrograde gastroscope used through the gastrostomie fistula. The study of the pylorus in health and disease at the Bronchoscopie Clinic for many years has yielded a large accumulation of data which is now being published. The method has an enormous field of usefulness in the class of cases for which gastro enterostomy is done. In many such cases it is advisable to put a tube in the stomach to create a fistula for subsequent treatment of the pyloric antrum by gastrostomie gastroscoopy.

The *technic* is the same as for retrograde esophagoscopy up to the point where the spine is encountered bulging forward the posterior gastric wall. When this is encountered, the distal tube mouth must be brought strongly anteriorly so as to go anteriorly to the spine in order to reach the pyloric antrum. Once the spine is passed finding the pylorus and entering the duodenum are not difficult. Often inflation of the stomach helps materially. For this purpose the window plug and the hand bulb are used. The quickest way to find the pylorus is with a string. This string may be swallowed by mouth, but ordinarily it is better to put about a meter's length of it into the stomach about ten hours or more beforehand. The outer end is sealed to the abdominal wall with an adhesive strip. Traction will demonstrate the firm anchorage of the distal end in the intestine.

I shall now demonstrate the methods by which the explorable regions are reached through the gastrostomie fistula.

**Case I.**—Female aged twenty-five years. Seven months ago this patient swallowed  $7\frac{1}{2}$  grains of bichlorid of mercury with suicidal intent. The burn of the esophagus was so severe that it was followed by complete aphagia, for which gastrostomy was done in another city. One month later esophagoscopy was done in the same city, and a diagnosis of cicitrial stricture of the esophagus was made. Weekly treatments were carried out, dilatation being attempted by bougies through the mouth. This was kept up for five months, but the patient's condition did not improve. She was then referred to us. Her condition on admission was such that she could swallow water at times, but only very slowly. The greater part of the time saliva was regurgitated. We attempted to have her swallow a string, but were unsuccessful, although she has co-operated very well.

We will therefore endeavor to string the esophagus by means of retrograde esophagoscopy. She is placed in the dorsal recumbent position as you see. We introduce the retrograde esophagoscope, find the posterior wall, and keeping the tip of the tube to the patient's left, we advance upward to the level of the costal margin. Then carrying the tip toward the spine and following the posterior wall, we locate the hiatus, and by making gentle pressure the tube passes into the esophagus. You will note that the patient is nauseated. This always occurs as the region of the hiatal esophagus is touched. The sand-pillow lifts the spine and we are able to get as high as the crossing of the left bronchus. At this point we encounter scar tissue on the posterior wall and the lumen ends in a very small opening. We now take a No. 8 Jackson steel-stemmed filiform bougie and introduce it by sight into the opening in the strictured lumen. Dr. Wagner now carries the patient's head below the level of the table so that the spine is straightened, and by making gentle pressure on the bougie the tip passes through the stricture. The patient gags and coughs, as you will note, indicating that the tip is well up in the pharynx. By means of a Jackson pillar retractor we pull the flexible tip out of the mouth and loop it over a silk thread, No. 10 surgeon's twist, and I now withdraw the bougie with the string attached. We

now have a string through the strictured esophagus, and at subsequent sittings we will pull upward the Tucker retrograde bougie in graduated sizes, dilating the stricture

The prognosis by retrograde bouginage is very good. In most cases we get quickly, and in all cases we get ultimately, a complete cure.

We have never had an unfavorable result and never the slightest reaction from the retrograde esophagoscopy nor from the retrograde bouginage since using the Tucker retrograde bougie.

Gastrostomie duodenoscopy has been in occasional use at the Bronchoscopic Clinic for many years as patients presented themselves with the dual combination of esophageal stenosis requiring gastrostomy and duodenal conditions amenable to local treatment.

While there are not many cases perhaps in which on a primary diagnosis we would advise gastrostomy for the sole purpose of treating the duodenum, our experience shows clearly that in such cases as those in which the surgeon at exploratory operation finds insufficient grounds for duodenal surgery, or for even a gastro enterostomy, the leaving of a gastrostomie fistula will enable us to cure minor duodenal troubles by local methods carried out through a sufficiently long period of time. In such cases the position in which the fistula is created should be such as to afford access to the pylorus with the least possible displacement, that is as near the median line as possible.

We have no intention of advocating the method as a substitute for gastro intestinal surgery in such cases as the surgeon may consider suitable for such measures. In some cases in which the results of gastro enterostomy have proved disappointing a second operation may furnish no further surgical indications. In such cases we think a gastrostomy to create a fistula for local treatment of the duodenum advisable.

The duodenum is easily entered after the pylorus is presented at the tube mouth. The duodenum in most individuals is not accessible to endoscopy beyond the first part. In some patients only a centimeter or two are accessible. In other individuals

as much as 4 cm are explorable. It is in this first part of the duodenum that over 90 per cent. of the duodenal diseases occur.

**Case II. Gastrostomic Gastroscopy for Treatment.**—This woman had regurgitation of food that was supposed to be vomiting. The abdomen was opened on a suspicion of cancer, with negative results, but the difficulty seeming then to be esophageal, a gastrostomy tube was left in for feeding.

She undoubtedly has a so-called cardiospasm, which, as Mosher has shown, is often dependent upon abdominal disease.

Gastroscopy through the gastrostomic fistula revealed an ulceration on the lesser curvature of the stomach close to the cardiac orifice. It was a flat granular bleeding area with edges merging into normal mucosa. Had it been suspicious of malignancy we would have taken a specimen. We have decided on treating and watching the area for a time.

One of these treatments will serve to demonstrate the method.

I now pass the retrograde gastroscope, find the ulcer, and make an application with a swab directly to the ulcerated area. The application in this instance is 20 per cent argyrol, but silver nitrate or any other remedy may be applied.

## RAPID, DEDUCTIVE DIAGNOSIS OF DYSPNEA REQUIRING TRACHEOTOMY

FEMALE child aged nine months was brought to the hospital almost moribund. The only history that we had was that the child had an attack of choking and coughing while sitting on the floor. It was brought into the operating room by Dr. Chee and laid on the table just as it was ceasing to breathe. It was intensely cyanotic in color, there were depressions due to deep indrawing at the suprasternal notch around the inner ends of the clavicles at the intercostal spaces and at the epigastrium. These evidences of laryngeal obstructive dyspnea were so obvious that Dr. Louis H. Clerf did a rapid low tracheotomy and we started artificial respiration.

After the child rallied sufficiently to do his own breathing I inserted a direct laryngoscope through the mouth and removed a piece of wood which was jammed back of the larynx in such a way as to obliterate the airway by compression.

The child promptly rallied and breathed quietly and normally. All the signs of obstructive laryngeal dyspnea disappeared promptly after the tracheotomy.

There are a number of interesting points to which attention should be called. In a case of dyspnea it is a matter of life-saving importance to recognize promptly whether or not the dyspnea is laryngeal. A patient dyspneic with asthma will recover and live for years, a patient with cardiac or renal dyspnea may live for days weeks or months under appropriate treatment. And so it is with many other forms of dyspnea. But with severe laryngeal dyspnea the patient may asphyxiate in a few minutes if the condition be not promptly recognized and if tracheotomy be not done.

Fortunately, we have infallible signs by which the well informed practitioner can recognize the laryngeal character of the dyspnea and distinguish it from all other forms of air hunger. The signs are

1. Indrawing at the suprasternal notch.
2. Indrawing at the inner ends of the clavicles
3. There may be also indrawing of the intercostal spaces and of the epigastrium.

When in a case of dyspnea you get a marked indrawing in the suprasternal and clavicular region it is unwise to postpone tracheotomy by waiting for cyanosis. As Chevalier Jackson has said, "We always preach doing tracheotomy early, but almost always do it late." In the present case we had nothing definite on which to base a diagnosis as to the cause of the condition, but that the child could not get enough air through the larynx was obvious. To wait for the taking of a history and the making of a diagnosis would have meant death to the little patient. All such cases in children demand direct laryngoscopy to see the nature of the laryngeal obstruction. It may be due to diphtheria, influenza, traumatism or other disease, or to foreign body. In adults the larynx could be looked at with the laryngeal mirror, but in children the only way is by direct laryngoscopy. In doing this we always prepare also for bronchoscopy. Had we known definitely that this patient had had a foreign body and if the dyspnea had not been extreme we would have looked at the larynx first; but with impending death by asphyxia tracheotomy is always in order not for foreign body, not for direct laryngoscopy, not for bronchoscopy, but to give the patient air, after which the diagnosis can be completed and the indicated relief afforded.

Still another interesting point is that a rapid tracheotomy can be done low in the trachea by splitting open the whole front of the neck at the first incision so that the trachea can be felt. There is no need for ruining the larynx by a laryngotomy or by attempts to stab the cricothyroid membrane.

## CLINIC OF DR WILLIAM F MOORE

DEPARTMENT OF DISEASES OF THE CHEST, JEFFERSON HOSPITAL

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### BRONCHIECTASIS AND PULMONARY ABSCESS

#### CASE I GENERAL PULMONARY SUPPURATION WITH BRONCHIECTASIS IN A CHILD, LOCALIZING UNDER BRONCHOSCOPIC TREATMENT

THIS case has been followed by us for some fourteen months with no little interest, first, because it was one of a series of 3, all of which had their inception in early childhood, with a similar etiology and showed clearly the common origin of lung damage from the inflammatory lung diseases of childhood particularly in association with the bronchial inflammation of measles and whooping cough, and, second, because being in a child of seven years we were anxious to see the amount of resultant damage to the lung tissue after actual suppuration ceased, and to follow, as we hoped, the case into adolescence and note changes from time to time. Please note that the child does not appear ill or toxic. This appearance has been so from the time he first was bronchoscopyed at the clinic. Although his cough was constant and severe and large amounts of purulent secretion were raised, the sputum has never had a foul odor characteristic of adult cases of bronchiectasis. The preliminary history of this patient is as follows. Male aged seven years. The chief complaint was that since the age of two weeks the child had constant cough with profuse expectoration, no foul odor, no fever, chills, night sweats, hemoptysis, or loss of weight.

The general health had been good.

Past Medical History —Whooping cough and measles, congestion of the lungs and influenza.

Physical Examination (Dr Elmer H Funk August 22, 1922) —A fairly well nourished child, no dyspnea, no cyanosis, weight about normal. Temperature and pulse normal.

*Chest*—Limitation of expansion on the left side with dulness in the left lower axilla extending around to the angle of the scapula. Breath sounds over this area are distinctly heard, but distant. Some squeaking, crackling râles are heard over the entire pulmonary area and some fine crackles over this area on the left side. The only other additional thing to be noted in this report is under "Extremities," and here a slight incurving of nails was seen.

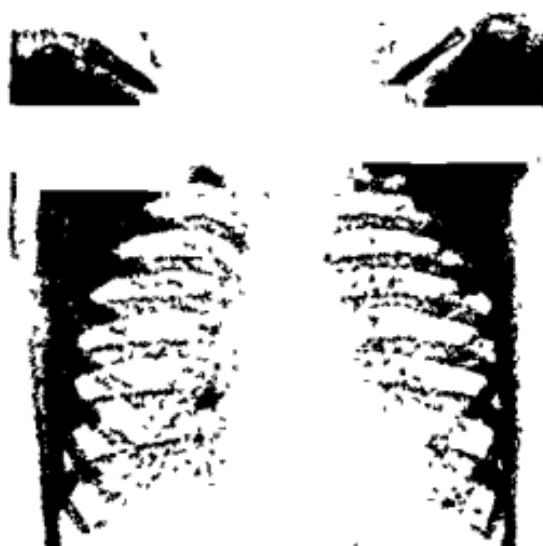


Fig. 33.—Case I. Generalized bronchiectasis in a child of seven years. Note also area above diaphragm of left lower lobe.

**Roentgen-ray Report (Dr. W. F. Manges, August 23, 1922)**  
—There is quite marked thickening at the roots of both lungs, which is evidently principally of an inflammatory nature. There are also a number of definitely enlarged glands present on both sides. There has evidently been some old infection in the left lower lobe. There is considerable fibrous thickening and bronchiectasis along the inner and posterior portion of the left lower lobe and extending outward to a little beyond the midpoint, just above the diaphragm, to the left of the apex of the heart. There is a small localized density which looks very much like a localized inflammatory process. In addition to this there is a definite

localized peribronchial thickening along the vertebral border of both upper lobes and many of these small bronchial shadows can be traced pretty well to the surface. My feeling is that this is a part of the process which is seen at the root area and in the left lower lobe. The characteristic markings of a tuberculous process such as beading or nodule formation are absent. I would feel however that if the lesions that are present in the lower lobe were not there the peribronchial thickening in the upper lobes might possibly be tuberculous (Fig. 33).

**Diagnostic Bronchoscopy**—Pus welled up from both main stem bronchi right and left in large quantities. This was aspirated. At subsequent bronoscopies the suppurating areas were located in both lungs.

Cultures made for autogenous vaccine from the pus showed growth of streptococci staphylococci Micrococcus catarrhalis.

**Bronchoscopic Treatment**—This child has been bronchoscoped sixty two times in the past sixteen months. The treatments consisted in aspiration of pus followed by irrigation with a solution containing 2 grains of picric acid and 7 drops of Lugol's solution in 1 pint of normal saline solution.

**Roentgen-ray Examination** (Dr. Manges)—Films taken today (Fig. 34) compared with those taken a year ago show a definite improvement in the condition of the lungs especially in the lower left lobe. There is less evidence of exudate also less fibrosis. The enlarged glands at the roots of the lungs reported on former examination are distinctly smaller and denser showing that they have undergone organization. The peribronchial thickening in the upper lobes shows practically no changes from the former study.

Bronchoscopy today shows the right main bronchus clear of secretion. A small amount of secretion in the left stem bronchus found coming entirely from the left lower lobe.

**Physical Examination** (Dr. Funk November 27, 1922)—Eight vaccine injections of bacilli before noted have been completed. The patient seems improved as the result of the combined bronchoscopic and vaccine therapy. The signs at the right base are however about the same. Mother states that

expectoration and digestive disturbances have considerably improved. In fact, there has been no gastric upset since the beginning of the treatment.

At the present time it cannot be claimed that this child is, as yet, cured; but the cure of the diseased areas in the upper part of both lungs, the lessening of the cough, the diminution of the

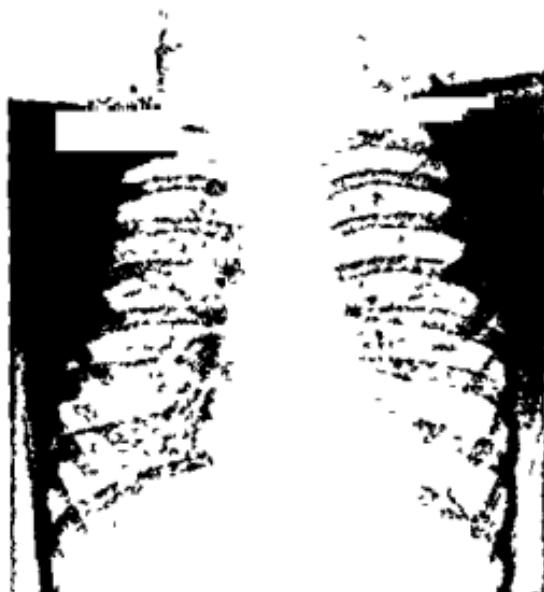


Fig. 34—Case I. Generalized bronchiectasis in a child of seven years. Suppurating area localizing one year after beginning of bronchoscopic treatments in the left lower lobe. Note that the dense area in the left lower lobe just above the diaphragm has cleared. Peribronchial thickening still shows

secretion, all indicate the ultimate cure of the remaining localized focus in the left lower lobe. Considering the usually intractable nature of bronchiectatic conditions and the little tendency to spontaneous recovery they show, the results in this case are remarkable.

The points of interest are these:

1. As the patient became accustomed to the treatment the amount of morphin given at first was gradually reduced and then discontinued.

2 The bronchi draining the right side of the chest ceased to drain pus, and gradually the focus as evidenced by the bronchi exuding pus at bronchoscopy became localized to the left lower lobe

3 The complete disappearance of the distressing gastric symptoms as the result of effective bronchoscopic treatment of the suppurative foci in the lungs

4 During a respite in the treatment at the tenth month all symptoms became aggravated. Treatment had been interrupted to permit the child to accompany the family to the sea shore

5 The child gained steadily from 44 to 55 pounds and is now quite normal in weight and appearance

6 No hospitalization was required at any time during these bronchoscopic treatments. The child returned to his home in the afternoon of the day of the bronchoscopy

#### CASE II PULMONARY ABSCESS FOLLOWING TONSILLECTOMY: RECOVERY AFTER PERORAL BRONCHIAL ASPIRATION AND MEDICATION

This woman, aged twenty one years has had a rather unusual medical history. The sequence of events would seem to have been as follows. First she had suffered for some months from tracheobronchial asthma of unknown origin. Seeking for some relief from this condition, the first operation done about the upper respiratory tract was on the nasal septum in June 1922. The symptoms were partly alleviated, but the benefit was not great nor long continued. Four months later a tonsillectomy was performed by a very able man. Shortly after the removal of the tonsils the asthma returned with marked severity and other pulmonary conditions developed.

*Physical Examination* (Dr Elmer H Funk, October 26 1922)—A well nourished female, temperature and pulse normal, tongue clean, lips slightly cyanosed, moderate respiratory dyspnea

*Chest*—Respiration rapid, squeaking and piping râles heard all over the chest. Following the hypodermic injection of

adrenalin the wheezing quieted down and the chest examination then revealed limitation of expansion in the right lower chest. Posteriorly the breath sounds are somewhat distant and a few crackling râles are discernible. Diagnosis was made at the time of this examination of bronchial asthma with localized infection of the right lower lobe.

**Roentgen-ray Examination** (Dr. Willis F. Manges, November 13, 1922).—There is a rather extensive peribronchial thickening of the lobes of the lungs on both sides and possibly also a rather

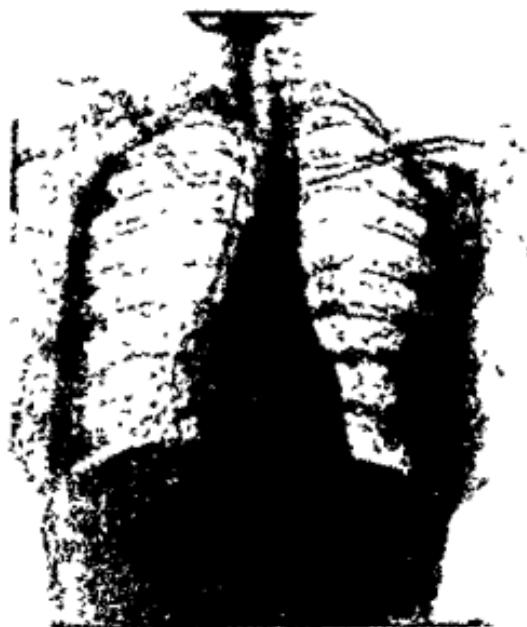


Fig. 35.—Case II. Pulmonary abscess following tonsillectomy. Suppurative area seen involving the right and middle lobe as a dense shadow at the hiatus. Before treatment.

large gland at the hilus on the left side. There is evidently considerable fibrosis and probably bronchiectasis in the lower half of the right chest, mainly in the lower lobe. The cause of this is not apparent. There is no recognizable foreign body, but I would suggest that you inquire very carefully into the history of possible aspiration of some foreign substance that might not cast a definite shadow. The upper lobes are practically clear except for slight bronchial thickening. One or two of the bronchi

are rather definitely beaded and especially in the first interspace trunk of the left upper lobe. I am inclined to believe that there is a very limited tuberculous involvement in this region, but this is less positive because of the evident chronic inflammatory process in the right lower lobe (Fig. 35).

**Protein Sensitization Test.**—Protein skin tests gave a negative reaction for all except goose feathers and orris powder, and the patient was accordingly advised against dust contact and the use of face powders, dentifrices, etc., also advised to use floss pillow and mattress.

On admission to the Bronchoscopic Clinic (November 27, 1922) she complained of shortness of breath. This symptom was more marked at night, compelling her "to sit up the greater part of the night." She had a productive cough, expectorating 3 to 4 ounces of purulent material in the twenty-four hours.

**Diagnostic Bronchoscopy** (November 27, 1922)—Mucous membrane of trachea apparently normal, thick viscid secretion coming from the middle lobe bronchus of right side. The upper lobe bronchus was free of secretion and normal in appearance. The lower lobe bronchi exuded no secretion while under observation. The mucous membrane surrounding the middle and lower lobe bronchi congested. No diminution of lumen. A specimen was taken directly by swab from the affected area for laboratory examination and making autogenous vaccine.

**Bronchoscopic Diagnosis.**—Localized suppuration involving the middle lobe on the right side and possibly also the lower lobe. In all, sixteen bronoscopies have been performed on this patient from November to April. During this time the middle and lower bronchi were aspirated and treated at seven-day intervals. After the first four bronchoscopic treatments bronchoscopic examination showed *no pus coming from the middle lobe bronchus on the right side*. The lower lobe bronchi were also free. About a month later a small amount of pus was noted coming from the inferior and middle lobe bronchi on the right side. This did not appear sufficient in amount to account for the symptoms, and treatment of the accompanying tracheo-bronchial asthma was started, the solution used being 4 minims

of a 10 per cent solution of cocaine, 20 minimis of a 1:10,000 solution of adrenalin in 10 c.c. of normal saline solution. Under this treatment the patient steadily improved until discharged five months after the first treatment.

Interim Notes (December 4, 1922, examination by Dr. Elmer H. Funk).—Patient has been free from asthma and has had her best week for a long while since the bronchoscopic treatment a few days ago. She feels encouraged by the results obtained and is perfectly willing to continue bronchoscopic treatment. Roentgen-ray examination is not thought advisable at present, but will be considered at some future date to determine if bronchoscopic drainage has cleared up the lung lesion. The physical signs of the asthma and of the local lesion have very largely cleared up. One finds only some suppressed breathing with a few fine crackles about the angle of the scapula.

Vaccine during treatment was made from cultures showing pure strains of streptococci and pneumococci, the former predominating. This vaccine was given in ascending doses twice a week, starting with 4 drops as an initial dose. This by January had reached  $\frac{1}{2}$  c.c., and at this time potassium iodid was also started by the mouth.

After the eighth bronchoscopy Dr. Funk reported as follows: The patient has just been bronchoscoped (about two hours ago) and there are a number of squeaking, piping sounds over both lungs. Basal signs have in a measure cleared up. At the apices the breath sounds are slightly rougher than over other portions of the lungs. I find it difficult to believe that the patient has an active tuberculosis, particularly in view of the fact that she has gained 20 pounds in weight during the past five or six months. From the physical examination I would feel that the basal lesion has improved as the result of bronchoscopic treatment and that the asthma has remained about the same.

The following Roentgen-ray report was made by Dr. Manges at this time: There are evident changes in the chest since the last examination, which was made before November 10, 1922. The thickening and evidences of bronchiectasis in the right lower lobe is distinctly less pronounced than it was before.

On the other hand, there is much more definite evidence of pathology in the upper lobes, and my feeling is that the diagnosis of tuberculosis is very much more clearly defined than it was on the former examination. There is not only peribronchial thickening, but there are also scattered foreign deposits in the parenchymal portion. The heart is displaced a little bit further to the right than in the former examination, as if there had been some contraction of the tissues in the right lower lobe.



Fig 36—Case II. Pulmonary abscess following tonsillectomy. Shadows of less density at hiatus, right and middle lobe, showing suppurative area replaced with fibrous tissue after four months' bronchoscopic treatment.

Roentgen-ray findings by Dr. Manges March 26, 1923: Films showed no evidence of previous tuberculosis and no evidence of abscess (Fig 36).

It is to be recalled that these lesions were definitely diagnosed by Dr. Manges on the two examinations one and two months previously. The disappearance of the abscess signs, physical and Roentgen ray, is probably the result of bronchoscopic drainage.

Blood examinations never revealed anything but normal counts and the Wassermann was negative. Four sputum examinations were negative for tuberculosis, showing only diplococci and other strains of streptococci. Six urine examinations showed nothing abnormal.

About the fourth day after a mild asthmatic attack Dr. Thomas McCrae saw the patient in consultation and could find no abnormal physical signs in the chest. His examination confirmed Dr. Funk's findings at the time. The temperature and pulse being normal and physical signs having cleared up, the patient was discharged from the service.

Summarizing, the points of interest are these:

1. This case would seem to afford evidence of the aggravation of tracheobronchial asthma by acute suppurative conditions in the lungs.

2. While no pathology of the mucous membrane of the trachea or bronchi, with the exception of those draining the suppurating area, was diagnosed at the first bronchoscopy, at later dates definite congestion and a spasm of the bronchial walls with thick secretion which clung to the mucous membrane was noted.

3. It is interesting to observe that the asthmatic attacks cleared after the focus of infection in the middle lobe of the right side was entirely healed.

4. It is instructive to follow the Roentgen-ray findings in this case, especially in regard to the displacement of the heart to the right. These healed areas are filled with fibrous tissue, the contraction of which causes the adjacent organ to assume a new position.

5. After a lapse of nine months since cessation of bronchoscopic treatment this patient remains free of asthmatic attacks and has successfully passed through a very trying pregnancy.

## CONTRIBUTION BY DR. WILLIAM S. NEWCOMET

JEFFERSON HOSPITAL

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### RADIUM IN CANCER OF THE LARYNX

At the present time there can be no general rules for the application of radium in malignant disease of the larynx. All cases, however, in which operation for some reason is not advisable should have radium applied. There are three distinct methods, and each has its advocates: first, cross-fire of the neck; second, application of the active radium capsule to the inside of the larynx; third, embedding the active capsule directly in the diseased tissue. If the last two methods are employed the active capsule may contain a radium salt or a small emanation seed. The seed is to be preferred, for an extremely high activity may be obtained within a relatively small tube, a few millimeters in length. The disadvantage of the last two methods is the amount of trauma produced and the severe reaction that follows. From the cases that have come under our own observation and that of others the cross-fire method seems to yield equally good results without the disagreeable features possessed by the two other methods. It possesses the advantage that it radiates the disease from the base outward, thereby reaching the more active portion.

The only difficulty in this method is the calculation of the proper areas upon the neck from which to radiate the disease without causing a too active dermatitis. In other words, the application should be a suberythema dose to the skin area and a calculated full dose at the focus of disease.

The following case referred by Dr. Chevalier Jackson may be given as an illustration of several that were treated by the cross-fire method: Case No. 508,697 came under observation June 21, 1921. A male, forty-four years of age, complained of

hoarseness for about a year and a half. There was neither cough nor expectoration. Family history was negative; no tuberculosis or cancer. General health excellent. Had exanthemata in childhood and a mild typhoid ten years ago. Never had diphtheria, pneumonia, rheumatism, or any serious injury or operation. Never smoked or used his voice excessively in his profession.

Hoarseness was first noticed while singing; it became worse and he had to give up his profession. He always felt better in the South, and the hoarseness always returned immediately when he came North. Several physicians were consulted and regarded it as a congestion of the vocal cords.

Examination of the larynx showed an overhanging epiglottis. Motility normal. Right cord edematous, with a small rounded mass at the middle portion. Edematous thickening extends into the right ventricle. Ventricular bands scarred. Left cords normal. Examination of the eyes, heart, lungs, and nervous system were negative. Wassermann was negative. A specimen of the growth examined by Dr. Crawford was found to be squamous-cell epithelioma. He was referred for treatment, with radium, and the first application was made on August 16, 1921. A 50-milligram capsule filtered by 1 mm. of lead and 1 cm. of wood was placed in eleven positions upon the neck for two hours each, making a total of twenty-two hours. A second application was made on September 22, 1921 of 100 mg., with the same filter, to ten positions, with a total of twenty hours. On November 3, 1921 a third application was made of 100 mg., with same filter, to eleven positions upon the neck for two hours each. And at this time the throat appeared to be better. On December 15, 1921 a fourth treatment was given. The local condition was much improved and the patient felt better. At this time only eight positions were used, two hours at each position, the amount of radium and the filters being the same as in the last application.

The next treatment was given March 30, 1922. The patient had improved; only a small slit remained at the site of operation, where the mass had been removed. At this time 100 mg. were

applied to twelve positions upon the neck the filters being the same as in the former applications a total of twenty four hours, two hours at each position A sixth application was made on July 20, 1922 At this time sixteen positions were used, one hour at each position The amount of radium and the filter were the same as in the last application

The condition of the larynx as observed by Dr Chevalier Jackson at that time was practically normal except that the right cord was slightly thicker than the left The motility was perfect Dr Chester H Bowers on November 21, 1923, reports the larynx to be normal except for the slight thickening of the right cord The general health of the patient is excellent

It will be noted that this patient did not suffer the slightest inconvenience while under treatment There was a slight dryness of the throat, which usually came on a few days after treatment and lasted for a week or ten days Where the direct method is employed the injury to the sensitive structures of the larynx especially the cartilage is so great that the inflammatory condition that follows adds greatly to the distress of the patient, and in some instances causes a rapid breaking down and sloughing of the tissues and sometimes a perichondritis which may be a serious complication

In those instances where there is a marked overgrowth of tissue and it has reached a considerable size radium may be placed directly in the body of the mass But large doses by any method are not justifiable about the larynx In the small ulcerative type the cross fire method should first be tried The ultimate result of the treatment may be judged by the amount of comfort the patient experiences following the application

In the postoperative or prophylactic application of radium the dosage is decidedly less than that given where active disease exists The interval between applications must be lengthened and continued for about a year after operation or disappearance of disease The interval to be governed by the character of the disease and the susceptibility of the patient The dosage should be enough to produce a very faint reddening of the larynx, and one that will cause the patient to complain of the same dryness

of the throat experienced when more active treatment is given. The amount of radium usually required to produce this effect is about twelve hundred to twenty-four hundred millicurie hours at one application over a number of areas and well filtered. This may be repeated in about six weeks, and modifications may be made according to the requirements of the case.

Even after the larynx has become normal it should be observed at frequent intervals for years afterward. One case under our observation recurred after a period of eight years.

If preoperative radiation is to be employed it should be used as far in advance of the operation as is consistent, and should not be of too great intensity. There is no necessity for pushing the dosage to such a degree that it will cause an active inflammation of the normal tissue, since it has been proved by experimentation and experience that abnormal tissue yields to a lower degree of radiation. But, of course, the dosage must be sufficient to produce a general local fibrosis. This accuracy of dosage makes all the difference between success and failure in the use of radium in cancer of the larynx.

## CLINIC OF DR FIELDING O LEWIS

JEFFERSON HOSPITAL

### RADIUM IN CANCER OF THE MEDIASTINAL ESOPHAGUS

CANCER of the mediastinal esophagus is by most surgeons considered an inoperable disease

Radium has been palliative in many cases but the accurate endo-esophageal application of radium presents a number of technical difficulties

Peroral esophagoscopic placing of the radium capsule is useful in some cases

Retrograde esophagoscopic placing has been very useful in many cases as I have before pointed out

In still other cases both methods combined have been used with advantage

In addition to endo-esophageal applications by whatever technic they are applied we have found it advisable to use deep radiation through both the anterior and the posterior walls of the chest at a point exactly corresponding to the location of the growth in the mediastinal esophagus

The particular point that I wish to present to you today is in regard to a method of localization for this external application

One of the greatest difficulties experienced in the treatment of malignant disease of the mediastinal esophagus by the use of radium has been due to the fact that in many cases it has been impossible to determine the extent of the malignant invasion. Retrograde esophagoscopy has been of great help in determining the extent of the growth as well as in facilitating the treatment of the malignant area over a larger surface. So far as I am aware there has been no method described which will give even approxi-

mately the extent of an esophageal involvement in a malignant growth which is the cause of stenotic symptoms.

By means of the Roentgen-ray and fluoroscopic studies in connection with peroral esophagoscopy one is able to determine fairly accurately the upper boundary of the growth, but it is difficult to determine the lower boundary.

When barium and bismuth mixtures are swallowed by the patient the fluoroscopist can see the fluid trickle through a narrow channel and then suddenly drop into the stomach, without coating the walls below the stricture. Nor can one by the means of Roentgen-ray films determine the exact extent of the growth.

We have tried to improve upon this method in those cases which have required a gastrostomy by introducing the retrograde esophagoscope into the esophagus until the lower margin of the growth is seen. A mark is made on the esophagoscope at the gastrostomy opening, and the distance taken from the mark to the distal end of the esophagoscope. In like manner the distance is taken from the upper teeth to the upper border of the growth with the peroral esophagoscope. These distances are then marked on the skin surface corresponding to the direction of the esophagus. The intervening space between the two measurements represents approximately the extent of the growth.

While I realize that this method is not absolutely exact, it seems fairly accurate, and especially so in subjects who are very thin or, as is usually the case, very much emaciated.

I shall now call your attention to a case in which this method was used.

This patient, aged forty-nine years, came to the clinic a few weeks ago complaining of difficulty in swallowing, which was first noticed about four months previously. This difficulty had gradually increased until the time of his first visit. It was with difficulty that he was able to swallow even fluids.

There had been no pain or cough, but there was a great loss of weight. There was no history of lues and his blood Wassermann was negative.

Physical examination by the Medical Department showed

him to be in practically normal condition with the exception of a secondary anemia. A gastrostomy was performed at once.

Roentgen ray examination by Dr. Manges revealed almost complete obstruction of the esophagus just below the level of the inner end of the clavicle. Esophagoscopy showed a non ulcerating lesion, hypertrophic in character, in the same area. The clinical picture was that of carcinoma of the esophagus. A biopsy done at this time was reported upon negatively.

Bare tubes representing 203 mc hours were introduced into the neoplasm through the esophagoscope and the following day 11,781 mc hours (distance 6 cm, filter 1 mm silver, 2 mm brass) over the anterior chest wall opposite the lesion. With the same filtration 11,439 mc hours were given over the posterior chest wall opposite the lesion. You can see how by means of these marks on the chest made by the combined use of the peroral and the retrograde esophagoscopes following the technic I have described to you enabled us to place these large doses with confidence in the accuracy of the placement.

At his next visit an esophagoscopy will be performed in order to inspect the diseased area and we feel justified in expecting improvement in his condition.

# CLINIC OF DR. LOUIS H. CLERF

JEFFERSON HOSPITAL

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## BRONCHOSCOPIC LUNG MAPPING IN DISEASES OF THE LUNGS

THE method of visualization of the tracheobronchial tree by the endobronchial insufflation of a substance opaque to the Roentgen ray is an important contribution of the bronchoscope to the diagnosis and localization of diseases of the lung.

With the ordinary stereoscopic plates the roentgenologist can see the outlines of the trachea and some of the larger bronchi, and in certain cases some of the smaller branches of the bronchial tree, especially if pathology is present. With the insufflation of an opaque substance not only the larger bronchi but these small ramifications can be clearly shown in the ray plate.

**Technic.**—To carry out this procedure an inert substance opaque to the Roentgen ray, such as bismuth subnitrate or subcarbonate, can be used for insufflation. Since the subnitrate may, under certain conditions, give off nitrites, we use the subcarbonate exclusively. The powder should be dry and free from lumps.

The bismuth is insufflated into the tracheobronchial tree with the aid of the Jackson bronchoscopic insufflator that I show you here (Fig. 37), introduced through a bronchoscope which is inserted through the mouth, into the bronchus, or to a position at the orifice of the bronchus or bronchial branch to be insufflated. In this way the mapping can be confined to a particular portion of the lung.

As soon as the bismuth has been insufflated stereoscopic plates should be made in the anteroposterior position and a lateral view taken with the insufflated lung toward the plate.

**Anesthetics Used**—In adults a local anesthetic is employed. A general anesthetic is never given. In children no anesthetic, general or local, is used.

**Untoward Effects**—No ill results have been noted following the use of this method of lung mapping in a large number of patients.

Ordinarily not more than two insufflators filled with bismuth subcarbonate are used in an adult. The combined contents of these is about 3 drams. In a normal person the greater part of this is expectorated within the first twenty four hours after insufflation and usually none remains after forty eight hours.

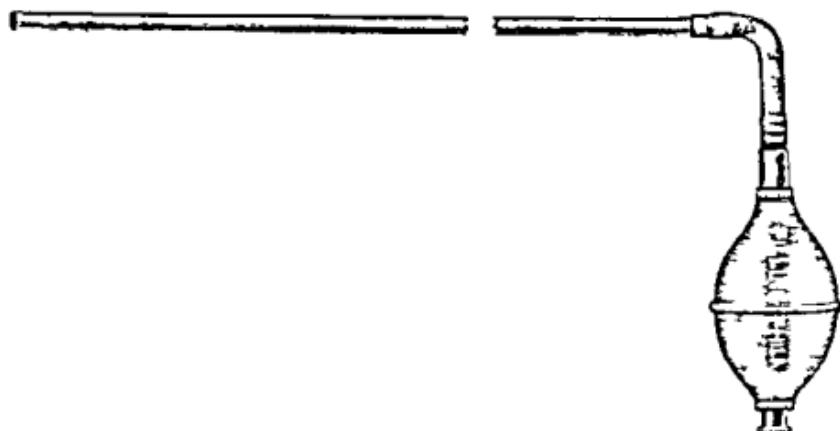


Fig. 37.—Chevalier Jackson's bronchoscopic insufflators for use in lung mapping by the insufflation of radiopaque substances.

Ray studies should be made at daily intervals until all the bismuth has disappeared from the lungs.

Since there is a temporary interference with aeration of the lung distal to the bronchus that has been insufflated, it is considered inadvisable to attempt mapping of more than one lobe at an examination.

I shall present 2 cases to demonstrate the importance and need of lung mapping in the diagnosis and treatment of diseases of the lung.

**Case I**—This man aged thirty four years was shot three years ago the projectile penetrating the upper right chest and

lodging in the left lung. He was perfectly well until one and a half years ago, when he developed a cough with expectoration of blood-stained sputum and began to have an occasional pulmonary hemorrhage. The advisability of removing the projectile was considered by a thoracic surgeon, who sent the patient to the Bronchoscopic Clinic to determine first the feasibility of extraction by bronchoscopy.

To decide as to the advisability of removal certain questions arose for consideration:

Could the foreign body, a penetrating projectile located in lung tissue, outside of the bronchial tree, be removed by peroral bronchoscopy? Or, Should it be removed by external surgery?

In order to answer these questions it was necessary to obtain the following information.

1. What is the position of the projectile in relation to the nearest large bronchus?

2. Would it be a safe procedure to penetrate the wall of this bronchus at a point near the projectile?

3. Could the projectile be reached with forceps penetrating the wall of the bronchus?

4. Is the lumen of the bronchus sufficiently large to permit removal of the projectile?

5. Are there any large blood-vessels in the path to be taken by the forceps or contiguous to the projectile?

On admission Dr. F. F. Borzell reported by Roentgen-ray examination that the bullet was in the anterior portion of the left chest on a level with the first rib anteriorly and that there were marked fibrotic changes in the tissues surrounding it.

In order that the roentgenologist might give a more accurate localization it was deemed advisable to map out that part of the air-passages contiguous to the foreign body. Bronchoscopic insufflation of bismuth subcarbonate was done by us under local anesthesia and stereoscopic plates were made by Dr. Leon Solis-Cohen. From these films, which I show you here (Fig. 38), it is accurately shown that the projectile is in close relation to the root of the left lung being slightly anterior to the bronchial tree and contiguous to the great vessels.

Because of the projectile's close proximity to the root of the lung with its very large vessels and the fibrotic changes in the surrounding tissue we concluded that bronchoscopic penetration of the bronchus and withdrawal of the projectile through the tissues, while mechanically easy of performance, would be an exceedingly dangerous procedure. An open external operation would be safer. We will therefore send the patient back to his physician with the opinion that this is not a case for bronchoscopic removal of the penetrating projectile.



Fig. 38.—Illustration showing lung mapping by the bronchoscopic insufflation of dry powdered bismuth subcarbonate. In this instance the insufflation was done for localization of the bronchi relative to the penetrating projectile.

With this harmless procedure of bronchoscopic insufflation of bismuth it was possible accurately to localize the projectile in relation to blood-vessels, bronchi, and mediastinal structures. A definite opinion could then be given regarding the safest method of removal.

My purpose in presenting this case is not so much to call your attention to bronchoscopic removal of penetrating projectiles, as to illustrate the importance of bronchoscopic lung mapping in localization.

7. Being less harmful than even needling, no hesitation need be felt in resorting to it in any case before operation.

8. Next to the Roentgen ray itself, bronchoscopic lung mapping we believe to be the greatest localizing aid to the thoracic surgeon yet discovered.

If you wish further information on this subject I would suggest that you consult Dr Chevalier Jackson's original article in the American Journal of Roentgenology for October, 1918.

## ATRESIA OF THE ESOPHAGUS

IN the treatment of cases of cicatricial stenosis of the esophagus previously gastrostomized for the dual purpose of relief of food and water starvation and of putting the esophagus at rest, we rely entirely on the Tucker retrograde bougie

In order to draw the bougie upward through the esophagus it is necessary first of all to have a string running from the mouth through the esophagus stomach and gastrostomy fistula, forming an endless chain. In those able to take food or water by mouth the string is gotten through by swallowing. This often requires patience and perseverance on the part of nurses and attendants. In the case of children under two years of age even if not absolutely atresic, the method we use for total atresia expedites the stringing.

In the event that the esophagus is completely closed by cicatricial stenosis or granulations as it was in the case that I shall present to you it is obviously impossible to get a string through without mechanical assistance.

**Lye Case No 131—Total Atresia of the Esophagus**—This little patient, aged ten years was sent to the Bronchoscopic Clinic by Dr Harold Watkins because of marked dysphagia. Nine months before admission he accidentally swallowed some "homemade lye."

There was severe burning of the lips, mouth, and throat with painful and difficult swallowing. The dysphagia increased progressively, and six months after the accident gastrostomy was done because of threatened food and water starvation.

On admission he was unable to take anything by mouth, even saliva could not be swallowed. Feeding was carried on through the gastrostomy tube. Dr W F Manges reported by the Roentgen ray examination that there was complete obstruction of the esophagus at the level of the lower border of the manubrium and the proximal portion was considerably dilated.

Retrograde esophagoscopy was done without anesthesia, local or general, using a 6-mm Jackson retrograde esophagoscope. At a point about 6 cm. above the hiatus esophageus a stricture was found through which the esophagoscope could not be passed. The substrictural esophagus was funnel shaped and showed no pouching

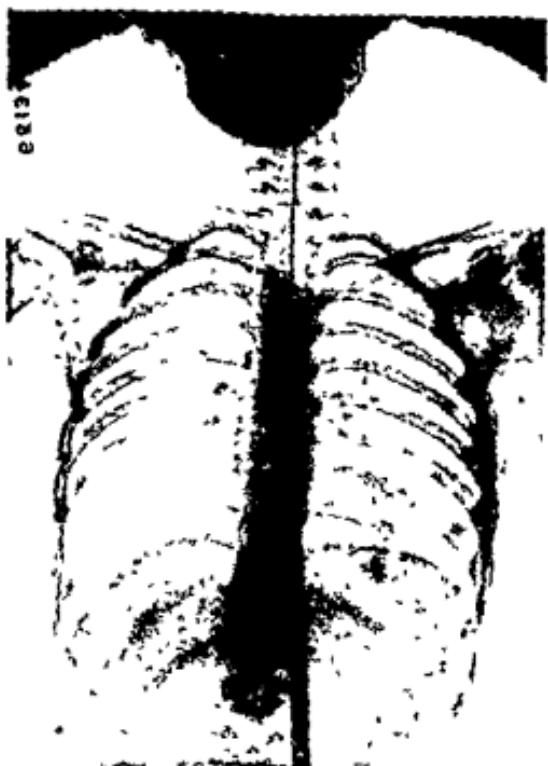


Fig. 41.—Roentgenogram showing the technic of retrograde esophagoscopic bouginage for the placing of a string in cases of atresia of the esophagus. The steel-stemmed filiform was passed from below upward by the aid of retrograde esophagoscopy without any anesthetic, general or local.

A filiform Jackson esophagoscopic bougie was passed through the stenosed lumen and continued upward until the flexible extremity was detected in the pharynx. This was recovered through the mouth and a fine silk thread was attached to it. With the esophagoscope the filiform bougie with the attached silk was then withdrawn, bringing the thread out through the gastrostomy fistula. This was replaced by a heavier silk string,

with which a No 10 (French scale) Tucker bougie was drawn upward through the esophagus with but slight resistance being felt. Thus a start was obtained in what looked like a hopeless case of total atresia of the esophagus.

The child has been treated twice weekly for several weeks and now is ready to go home to his physician, who will continue to carry out the necessary treatments.

The prognosis for ultimate cure is excellent.

The technic of retrograde bouginage for placing a string will be better understood by looking at the roentgenogram that I show you here (Fig. 41).

In this case there was no attempt made to pass a bougie through the mouth to carry through a string. To attempt to force a way through a total atresia of the esophagus is an exceedingly dangerous procedure even if there were a lumen, because as Dr. Jackson has clearly shown, these strictures are very often multiple and their lumina are located eccentrically. Moreover, there is in all long standing cases dilatation with sacculation of the esophagus above the point of stenosis. To pass a bougie through such a tortuous passage is exceedingly dangerous and often impossible. When approached from below the substrictural esophagus is seen to be funnel shaped with no redundancy of folds or dilatation to interfere with the upward passage of the bougie. With gentle handling this procedure is relatively safe.

**Conclusions** —(1) Retrograde bouginage, using the Tucker bougie, is the ideal method in the treatment of gastrostomized cases of cicatricial stenosis of the esophagus.

(2) Peroral esophagoscopic bouginage for the introduction of the string in cases of absolute atresia of the esophagus is exceedingly dangerous.

(3) Retrograde esophagoscopy we consider the safest method for the passage of the string in total atresia or in cases of stenosis if mechanical assistance is required.

## CONTRIBUTION BY DR. THOMAS A. SHALLOW

JEFFERSON HOSPITAL

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### GASTROSTOMY. AN IMPROVED TECHNIC

A SERIES of 80 cases in my work in Professor J Chalmers DaCosta's service at Jefferson Hospital has led to an improvement in the technic of gastrostomy that has given us a lower mortality and a greater freedom from complications than seems to be the experience elsewhere

**Mortality and Results.**--Professor J. Chalmers DaCosta in Modern Surgery, 8th edition, states that up to 1884 the mortality was estimated at 80 per cent. In more recent years the mortality of gastrostomy in malignant diseases of the esophagus has been estimated at 20 to 25 per cent, and in non-malignant diseases at from 8 to 10 per cent, figures which are decidedly greater than shown in our experience

It is our conviction that if gastrostomy is done early, while the patient is in good condition, using this method, the operative mortality need not be over 1 per cent. Dr Chevalier Jackson has said, "As with tracheotomy we always preach doing gastrostomy early, but always do it late"

Our statistics show that in the four years this improved operation has been done at Jefferson Hospital we have operated upon 80 patients. Counting as operative deaths all patients who died from any cause whatever within two weeks after operation, there were 8 deaths. In determining the value of the improved operation it is necessary to eliminate 3 of the cases. One of these was a newborn infant with esophagotracheal fistula, an essentially fatal condition. One child was moribund from a septic mediastinitis, an extension of cervical cellulitis; and one adult was dying of lymphosarcoma of the upper thorax and neck. Many of the patients were almost dead of water

starvation and presented the symptom complex of acidosis, but, regarding this as one of the necessary risks of the operation, there were 5 deaths in 80 cases. None of the patients died of secondary hemorrhage which so often follows the older forms of operation.

In this series of 80 cases the patients varied in age from two days to seventy five years. The causes of the dysphagia in the various cases were as follows: tracheo esophageal fistula, stricture following the swallowing of lye, esophageal diverticulum, and malignant disease of the pharynx or esophagus. In addition to the above-mentioned obstructive causes of dysphagia, we operated for Professor Dercum upon a case of non obstructive dysphagia in which the difficulty in swallowing was due to glossolabio-pharyngeal paralysis. In 30 patients the operation was purely a palliative procedure to render possible the nourishment of the patient. In 50 patients the fistula was used not only to nourish the patient but to permit of gradual dilatation of a cicatricial stricture of the gullet with the Tucker retrograde bougie. The cause in the cicatricial cases was the swallowing of lye. In the cases of diverticulum of the esophagus the purpose of the gastrostomy was to prevent hunger and thirst and at the same time put the esophagus at rest during the period of healing of the diverticulectomy.

The cases of cicatricial stenosis were referred from the Bronchoscopic Clinic, where Dr. Clerf and Dr. Tucker ultimately cured practically all cases. The ideal operation in these curable cases is to leave the stomach as nearly normal as possible after the tube has been removed permanently. The operation which we have developed is of such a character that it will not materially distort the wall or lessen the cavity of the stomach to any considerable degree, and will not demand a secondary operation to close the fistula.

To obtain this ideal result it is necessary that in the construction of the gastrostomy opening certain things be borne in mind. The fistulous tract must be at a right angle to the abdominal wall, so that the opening in the stomach corresponds with the opening in the belly wall. It must be of such

length and diameter that the retrograde esophagoscope can be introduced within three weeks or a month after the surgical procedure without causing hemorrhage or leakage into the peritoneal cavity. The tract created must be maintained patent by the mere retention of the tube. In the cases of lye strictures the tube may be retained for two years. In the cases of cancer it will be retained for life.

A secondary operation to close the opening is, of course, undesirable. It subjects the patient to unpleasantness and exposes him to a certain small, but definite risk.

We wish to emphasize the fact that in the non-malignant cases the operation has a definite purpose besides that of placing the patient in a condition that he may be fed. It permits retrograde esophagoscopy and retrograde dilatation with bougies used under direct vision by means of the esophagoscope. In all these cases the areas of esophagitis and ulceration are promptly healed by putting the esophagus at rest. Even in malignant cases the esophagus opens up as the result of stopping the irritation of foods passing over and lodging in the growth. In malignant cases the fistula is to be of such a character as to permit of the introduction of radium to the lower portion of the growth.

Certain factors determine the exact type of operation to be used in a given case, for instance, the size of the stomach, which varies considerably. Contrary to our expectations, it is not the rule to find the stomach of a child contracted to the same proportional degree as the stomach of an adult. In a case of carcinoma of the esophagus in an adult we expect to find the viscera greatly contracted; and consequently the termination of the vessels of the greater and the lesser curvatures will be found to be separated on the anterior wall of the stomach only by 2 or 3 cm., or a little more. It becomes evident, therefore, that in malignant cases in which we have a contracted stomach it may be extremely difficult to obtain a sufficient space upon the stomach free from blood-vessels upon which to perform a satisfactory gastrostomy. In most persons who are greatly emaciated the retracted abdominal wall is in close contact with

the anterior wall of the stomach. In some cancer cases, if there is emphysema of the lungs, the anterior abdominal wall is found to be a very considerable distance away from the anterior wall of the stomach. This is due to the fact of a flanging of the ribs which normally holds the abdominal wall away from the wall of the stomach.

When should we advise the operation of gastrostomy? Too much emphasis cannot be laid on the early diagnosis of dysphagia eliminating the functional nervous disorders in which dysphagia is a transient symptom. We obtain the advice and diagnostic aid of a bronchoscopist for the direct examination of the esophagus. This esophagoscopic examination is made at the earliest possible moment. Direct vision and the taking of a specimen for histologic examination obviate all guesswork and all delay. Early Roentgen ray examination is of utmost importance in all cases of dysphagia. Too many of the cases of carcinoma of the esophagus, because of delayed diagnosis, come to operation greatly dehydrated, emaciated, and suffering with acidosis. They are unable to swallow even liquids. This symptom presents dangerous grounds for any surgical or direct examination no matter how trivial. We therefore strongly recommend operation at a time when the individual reaches the stage of semisolid diet.

If we investigate what is the one generally accepted cause of malignancy "chronic irritation," and if we wish to at least lessen an aggravating cause, "chronic irritation," we should advise early gastrostomy. A certain degree of the obstruction is spasmodic and is associated with inflammation and edema even in malignant cases. The presence of these factors is proved by the return of swallowing function after the esophagus has been at rest for weeks, without any effort to dilate the stenosed lumen.

Of course no surgeon would forcibly dilate malignant stricture of the esophagus any more than he would forcibly dilate cancer of the pylorus or cancer of the rectum. Forceful dilation of any carcinoma opens up lymph channels through which metastatic processes will surely distribute the cancer to form

new foci, thereby shortening the life of the patient, adding to his sufferings, and lastly, preventing therapeutic measures in the form of radium or  $\alpha$ -ray treatment from having any effect, even palliative.

Technic.—There are several methods of doing this operation in use at the present day. All of these methods have certain shortcomings.

The Ssabanajew-Frank fistula does not enable us to pick up the string for the Tucker retrograde bouginage. Furthermore, the fistula in this operation does not permit the easy introduction or the satisfactory employment of the retrograde esophagoscope, gastroscope, pyloroscope, or duodenoscope. From the purely surgical viewpoint a grave objection to the operation is that if the stomach be shrunken, it is not possible to pull a sufficient cone of the stomach wall without undue and perhaps dangerous tension.

Another procedure which has been largely used is the Witzel operation. This operation is undesirable for the reason that the wound in the stomach and the opening in the abdominal wall do not directly correspond. The fistula not being vertical, the tract makes an angle with the stomach opening. It is true that the two openings eventually approximate, but they do not do this for many months. Another objection is identical with the one already mentioned against the preceding operation. It does not permit the catching or the drawing out of the string; nor does it admit of the subsequent use of the retrograde esophagoscope, pyloroscope, gastroscope, or duodenoscope. Furthermore, the Witzel operation lessens the size and distorts the wall of the stomach to a considerable degree, and it places the gastric orifice of the fistula too near the pylorus and too far from the cardia. In cases in which surgeons have placed the tube transversely rather than in the long axis of the stomach, an hour-glass stomach has of course resulted occasionally.

An operation which has well deserved elements of popularity was devised by Kader.

Perhaps the most used of all the operations for gastrostomy is that of the younger Senn.

A consideration of some of the elements of the Kader operation and of some of the elements of the Senn operation led to the operation which we perform in Doctor DaCosta's Clinic. This operation eliminates the very definite shortcomings of both the Senn and the Kader operation.

The fixation of the tube by the primary purse string stitch of Senn is very valuable in preventing leakage and securing valve formation. The inversion stitch of Kader gives broad surfaces and a long channel for approximation, and also creates a valve, though perhaps not as valuable a one as that formed by the Senn operation. The apposition of broad peritoneal surfaces in the Kader operation favors rapid healing after the removal of the tube.

The Kader operation although it uses considerable of the stomach wall, does not constrict as many large vessels as the Senn operation, and hence creates less liability to necrosis and hemorrhage. The Senn operation shows a definitely greater liability to serious postoperative hemorrhage than the Kader operation. The stitches compress large blood vessels coming from the curvatures. Such constriction makes necrosis possible and necrosis will result in leakage into the peritoneal cavity. The vascular constrictor may be responsible for secondary hemorrhage which may be fatal. The several purse string sutures of the Senn operation use up a very considerable area of the stomach wall, hence distort the wall, and lessen decidedly the cavity of the stomach. Either of these methods, it is true, permits the catching of the string and the bringing of it out of the fistula, and also allows the use of the retrograde esophagoscope, gastro-scope, pyloroscope, and duodenoscope.

We have sought by the operation herein described to (a) Use up as little as possible of the stomach wall, (b) to constrict the arterial supply as little as may be and thus to avoid leaking and hemorrhage, (c) to oppose fairly broad surfaces of peritoneum, (d) to make a fistula through which the string can be caught and drawn out and through which the esophagoscope and bougies can be used, and through which radium can be introduced, if necessary.

**Anesthesia.**—In all our patients over twelve years of age local anesthesia was employed and gave the utmost satisfaction.

The agent employed was a solution of novocain of the strength of  $\frac{1}{2}$  of 1 per cent. In children under twelve years of age ether was used.

**Steps of Operation.**—In the operation which we now describe the incision of the abdominal wall is made at the outer edge of the left rectus muscle and is about 3 inches in length

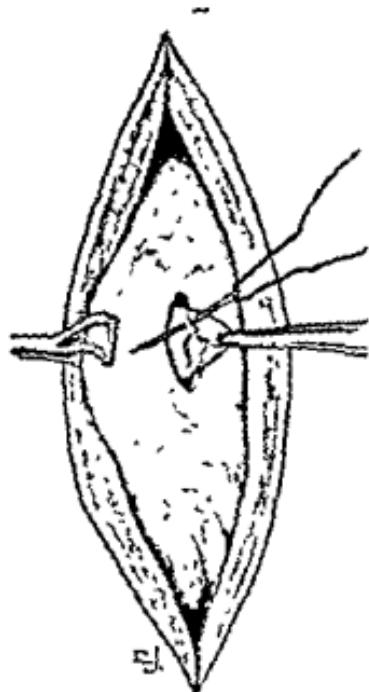


Fig. 42.—Gastrostomy by an improved technic. The stomach wall is drawn out and held securely with Babcock forceps. A small nick, no larger than will fit the catheter, is cut with the scissors in the muscular coats, being careful not to cut the submucous coat. The rat-tooth forceps are inserted and a little cone of the mucosal layer is drawn out through the opening in the muscular coats. The vessels in the submucous coat are ligatured by passing a needle under them on each side of the intended cut to be made in the mucous and submucous coats.

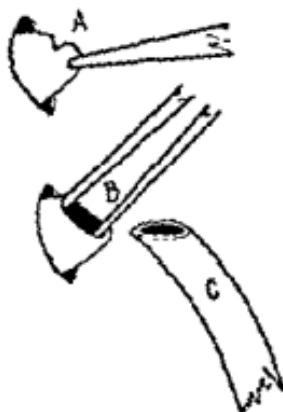


Fig. 43.—The cone of the mucous and submucous coats drawn out after the vessels are ligatured, as shown in Fig. 42, are nicked with the scissors as shown at A. A rat-tooth forceps is then inserted in the nick and allowed to expand (B), but only enough to enlarge the opening sufficiently to permit of insertion of the rubber tube, C, which is cut off with a slant to permit easier insertion at a close fit.

An opening is to be made through the anterior wall of the stomach as high in the cardiac portion as possible and midway be-

tween the greater and lesser curvatures of the stomach a point being selected which is as free as possible from blood vessels If the stomach is not decidedly shrunken, such a point can be easily found, but in cancer cases in which the stomach is much shrunken it may be scarcely more than an inch in width, and, in consequence the termination of the blood vessels of the greater curvature will be almost in contact with the blood vessels of the lesser curvature In such a case it is impossible to obtain a non vascular area The wall of the stomach is picked up with a rat tooth forceps a small nick with the scissors is made which is to extend down to but not through the submucous coat Any visible vessels in the submucous coat are pushed aside by the blunt end of the closed scissors Such separation of the vessels should expose an area of the submucous coat about 7 mm in diameter If it is found impossible to push them aside, each vessel is tied in two places before the opening is made into the stomach, so placed that when the opening is made into the stomach the vessels are divided between the ligatures (Fig 42) In order to open the stomach the submucous coat and the mucous membrane are picked up together by means of a rat tooth forceps and nicked by the scissors (Fig 43 A) The opening is to be just sufficient to admit the point of the rat tooth forceps when the blades are closed While the point of the forceps is in the stomach the blades are allowed to open, but only to such a width that a soft rubber catheter No 24 of the French scale, can be introduced into the stomach between the blades of the forceps (Fig 43, B) The point of the tube is put into the stomach about a distance of 1 cm from the opening in the anterior wall The tube is then anchored by means of a stitch of No 1 iodized catgut the stitch being passed through all the coats of the stomach and catheter on one side and all the coats of the stomach on the other side (Fig 44) This stitch is then tied This eliminates the need of any other hemostatic stitch as generally employed in other operations We emphasize the absolute necessity of making the opening in the stomach no larger than the tube We also emphasize the importance of the size of the tube We have seen more than one

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The agent employed was a solution of novocain of the strength of  $\frac{1}{2}$  of 1 per cent. In children under twelve years of age ether was used!

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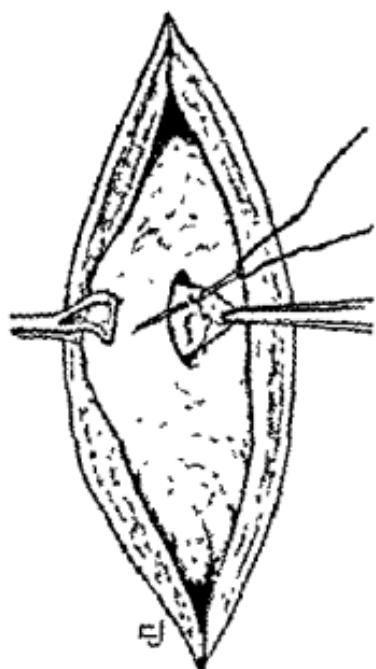


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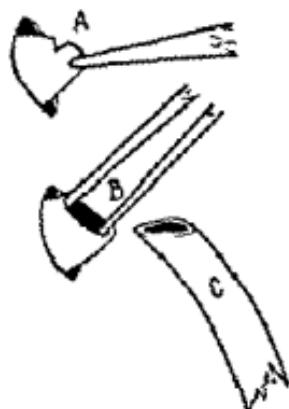


Fig. 43.—The cone of the mucous and submucous coats drawn out after the vessels are ligatured, as shown in Fig. 42, are nicked with the scissors as shown at A. A rat-tooth forceps is then inserted in the nick and allowed to expand (B), but only enough to enlarge the opening sufficiently to permit of insertion of the rubber tube, C, which is cut off with a slant to permit easier insertion at a close fit.

An opening is to be made through the anterior wall of the stomach as high in the cardiac portion as possible and midway be-

of Senn. This will surround the tube firmly, make it water tight, invaginate the coats of the stomach, and form a valve. After this it is not necessary to introduce any other purse string.

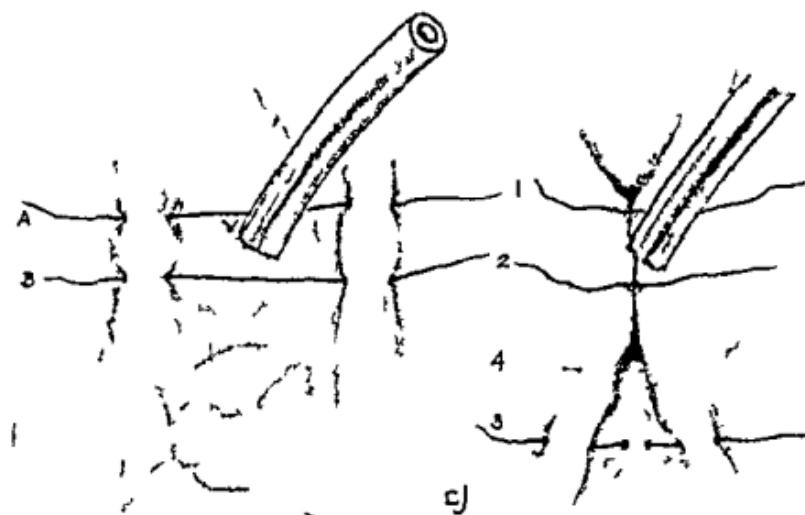


Fig. 45

Fig. 46

Fig. 45.—The tube being fixed as shown in Fig. 44 one purse string suture is placed tied and cut off short. Only one purse string suture is used. This dispensing with the strangulation of the tissues by the three tightly drawn purse string sutures of the Senn operation obviates leakage from the necrotic and sloughing processes with consequent hemorrhage. Two Lembert sutures (*A*, *B*) are placed one above and one below the tube. These are tied and temporarily left long for anchorage later.

Fig. 46.—The two Lembert sutures, placed as shown at *A*, *B* in Fig. 45 are tied as shown at 1 and 2 and temporarily left long. The next suture is the very important dam suture shown at 3. This suture passes through the folds like the Lembert sutures but in addition it takes up a fold in the channel between the two ridges raised by the Lembert sutures. The purpose of this is to place a dam in the channel left by a Kader operation, which channel is so often a cause of leakage. This dam suture is one of the great advantages of the improved technic. One of these dam sutures is placed above as shown below the tube in this illustration. All these sutures are in the same plane. The two layers of Kader are avoided.

stitch. Our custom is to introduce next a Lembert stitch above the tube and another Lembert stitch below the tube, each one being about 7 mm away from the tube (Fig. 45 *A*, *B*). We

by using only one purse-string suture instead of the three sutures of Senn.

4. There is less distortion and less stomach wall taken up because of a single purse-string, and especially because only a single pair of folds is taken up instead of two double folds, as in the Kader operation. This is of great importance in the shrunken stomachs often encountered in these cases.

5. Another advantage of this operation is that, in the curable class of cases, no secondary operation is needed to close the fistula.

6. The fistula is the most favorable in form, angle, and position for retrograde esophagoscopy, gastroscopy, pyloroscopy, and duodenoscopy. It also serves admirably for retrograde introduction of radium as advocated by Dr. Fielding O. Lewis.

7 In this series of cases I have not considered the excision of the esophagus, a procedure which must be at least thought of in the early cases of malignancy. I therefore have emphasized the importance of early diagnosis by means of the esophagoscope and the Roentgen-ray examinations of the esophagus at a time when the dysphagia is beginning to manifest itself. The esophagoscope has proved itself such an early, positive, and safe method of diagnosis that at Jefferson Hospital we all, internists and surgeons alike, feel that esophagoscopy for diagnosis should be done in every patient presenting the slightest symptom referable to the swallowing function. We consider blind bouginage dangerous in practice and misleading in diagnosis. The day of inferential diagnosis of esophageal disease is past.

CLINICS OF DRs JOHN B DEAVER  
AND  
STANLEY P REIMANN

LANKENAU HOSPITAL

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ESSENTIALS OF SURGICAL DIAGNOSIS

IN my work in the Lankenau Hospital Dr Stanley P Reimann Chief of the Pathological Department is in intimate touch with me and my patients at all times and I am glad to say to the interests of both Without this intimate association I am sure my part of the work would not be as successful as I hope it is, and I have taken pleasure in associating him with me in the preparation of this discussion

Surgical diagnosis comprises not only the diagnosis of the condition for which the patient seeks the surgeon's aid, but embraces as well the operative diagnosis and the diagnosis of post operative conditions

The essentials of surgical diagnosis do not materially differ from those of medical diagnosis in that the history of the patient needs to be most carefully taken and studied and the patient thoroughly examined This as I view it is the keynote to diagnosis In certain classes of patients however it is not possible to obtain an accurate history, one must then depend upon the examination and upon intuition

The interpretation of the history is the second most important factor This must be done in a logical manner all the points brought out and carefully analyzed in a deductive way Patience and concentration are essentials if the interpretation is to be correct

It has always been my practice to impress this upon my surgical interns Often careful consideration of the minor p-

brought out is of as much if not more importance than are the more prominent ones

In eliciting a reliable history it is best to allow the patient to state his case, then to follow with a series of careful questions, none of which should be too leading. The manner in which the patient is approached tells for much; one should not be too serious when interrogating the patient, should show sympathy with him, and convince him that one wishes to shed all the light possible on his case so as to return him to normal health. An antagonistic attitude on the part of the doctor cannot do other than thwart his efforts to obtain the truth.

In operative cases the history should be reviewed with the patient when he is convalescent, when additions and perhaps corrections can be made, thus assuring a better and more reliable record. The patient's attitude of mind before the operation may be such as to render it impossible for him to recall all the points in his illness. I insist upon my interns reviewing their histories in this way.

The construction of the history should also receive careful attention. It must be borne in mind that the history is a matter of record not only for present use, but for possible future purposes of statistics, research, and the like. Careless phraseology and poor inaccurate arrangement of the sequence of events as they occurred are misleading. Above all, it is important not to omit dates of previous illnesses, previous operations, and the dates of events of the present illness. For example, "last Friday or Saturday" in two or three years from now will convey very little information unless the calendar is consulted in reference to the day of the week of the admission of the patient, which makes unnecessary trouble and is altogether a careless and thoughtless way of stating the case.

After having made up one's mind as to the probable diagnosis the next essential is the physical examination. In the abdominal case this should first consist of inspection with the patient lying straight and flat upon his back. When inspecting the abdomen note whether the contour of the two sides is the same, or whether there are abnormal prominences or depressions.

present on the one side that are not on the other. The patient should be asked to breathe moderately deep, and very deep with the mouth open, and then the observation should be repeated.

The diagnosis of acute appendicitis can often be made, for example, by asking the patient to breathe moderately deep, or by having him take a very deep breath, first slowly, then quickly; he will most likely tell you this causes pain in the lower right abdominal quadrant. Ask the patient to place his fingers on the spot that hurts, and he will place them over the appendical region. This localized point of pain can be further demonstrated by having the patient cough. While this is also true in acute conditions of the *upper* abdomen, it cannot be so clearly demonstrable on account of the proximity of the diaphragm to the inflamed area. In the very acute abdomen the abdominal walls will be more or less or entirely immobile at and around the point where the inflammation is most intense.

After having carefully inspected the abdomen and drawn one's conclusions, careful palpation, percussion, and auscultation are next in order.

Palpation constitutes one of the diagnostician's most important assets. To palpate, and elicit the utmost that can be learned from this method of examination, is an art. It is done by contact with the finger-tips as well as by the flat hand. Lightness of touch is essential, and I regret to say that not everyone possesses it. It can be acquired, it is probably inborn, however, we should aim to acquire it. Next to the history, palpation, percussion, and auscultation are the most important methods of making an abdominal diagnosis. This statement is made with full consciousness of the value of the x ray. Incidentally it may be remarked that in the acute and especially in the ultra acute abdominal conditions we are not able to make use of the x ray. Palpation will detect masses, swellings, irregularities, sudden movements, rigidity and flaccidity of the abdominal walls, tenderness, pulsations, the movement of gas, fluctuation, resiliency, tenderness, and in some instances hardening of the intestinal wall as the peristaltic wave passes along it, as in a hyperperistaltic coil of bowel. Superficial and deep pal-

pation with the fingers and with the flat hand, during absent as well as during moderate or deep breathing, will often detect swellings, enlargements that otherwise might be missed, such as the mobile kidney, the enlarged gall-bladder, etc. This is made all the more possible if the examiner has a good working knowledge of anatomy, that is, is familiar with the topography of the various organs I have many times stated that exquisite tenderness is a more reliable sign of the presence of pus than is a leukocyte count, and up to the present time I have had no reason to change my mind as to this It has been well said that the best road to becoming a surgeon is the road to and from the dissecting room. To this I would add the roads to the physiologic laboratory and the postmortem chamber. There is no greater essential to surgical or medical diagnosis than knowledge of physiology carried to the bedside, and to obtain the most from the study of living pathology one must have built its foundations in the dead house It is usually too late to begin to acquire this knowledge after graduation; this would be like making a version and delivering the placenta before the child. Here it may again be remarked for the benefit of those directing the education of medical students that the fundamentals of a sound medical education are in danger of being omitted, and in their place the accomplishments of the finished doctor are being taught, this is like eating the dessert first and the dinner afterward. In my experience in teaching interns I find they are rarely familiar with the dissecting forceps Ask for a dissecting forceps and you often will be handed a tissue forceps Partly in keeping with this they have been taught microscopic and not macroscopic anatomy, and so down the roster. With an understanding of the anatomic relationship between the respective organs palpation will be more enlightening This relationship, however, can to a great extent be clouded by pathologic inroads, and then the knowledge gained by long service in the dead house and in the operating theater, where living autopsies are being made daily, will chart the horizon

Percussion is as essential to the surgeon as to the internist.

The benefit of this aid to diagnosis is frequently obtained by shifting the patient from one position to another. It will not be necessary to dilate upon this more than to say that the sense of hearing is an important supplement, either used alone or with the aid of the stethoscope, which for those accustomed to its use is perhaps the more reliable. Where there is abdominal tenderness the latter has the advantage over the direct application of the ear, in that there is less chance of increasing the patient's discomfort; and in postoperative cases also, on account of the presence of the abdominal bandage, the stethoscope can be used with less annoyance to the patient.

Auscultation in abdominal diagnosis and especially in the acute abdomen is extremely useful if one is conversant with the character and site of the normal intestinal sounds and their alterations in tone, intensity, etc.; it is an indispensable aid in forming a correct conclusion of what is going on within. In the diagnosis of aneurysm, hearing the bruit clinches the diagnosis, while if there is not a true aneurysm, but only dilatation, not to auscult would possibly be to lose out if the more modern means of making this diagnosis by x-ray is not applicable. The x-ray is a very pliable method, yet this should not be used to the exclusion of auscultation, palpation, and percussion.

In abdominal diagnosis auscultation serves its most useful purpose to the surgeon in the determination of the different varieties of peritonitis, as it enables him to decide in favor of an immediate or delayed operation, as the case may be. In the presence of a peritonitis it is my practice first to auscult the abdomen, and note the different types of peristalsis. In chronic intestinal and in early acute obstruction there is hyperperistalsis, while hypoperistalsis is heard in the presence of paresis of the muscularis of the intestine due to infection, the plexuses of Auerbach and Meissner being put out of business. Tinkling is heard when the bowel proximal to the site of the obstruction is greatly distended, as well as where there is extensive paralytic distention; ominous physical signs which cannot be too much stressed.

Auscultation in peritonitis with the localization of the in-

*traperitoneal lesion is of the utmost importance in determining the question of the time for operation.*

Auscultation in the presence of a limited, diffusing, and diffused peritonitis will determine the absence of or diminished peristalsis over the involved area in comparison to that heard beyond. Immediate operation is indicated in the presence of a circumscribed peritonitis, where the signs are obscured or where peristalsis is diminished over the involved area, with normal or slightly exaggerated peristalsis distal to as well as immediately around the site of inflammation. Palpation will have elicited a point of definite tenderness corresponding to the site of the lesion. On the other hand, if, in the presence of a diffused peritonitis, there is absence of peristalsis, a silent belly in other words, with the pulsation of the aorta abnormally distinct, and inability to localize the original focus, operation should be deferred if the best results are to be obtained. The presence of tinkling, significant of paresis and a distended bowel, is often a serious sign, and should tell the surgeon to stay his hand and await the result of treatment, consisting of anatomic and physiologic rest, *i. e.*, lavage, Murphy drip, intermittent or continuous hypodermoclysis, etc.

It is in respect to the physical examination that the old school excelled, and why? Because sight, touch, and hearing were for a long time the only available armamentarium of the diagnostician, and the man who had trained these senses to the utmost delicacy was the man of whom it was said. "He has the power of diagnosis in his finger-tips." These gifts are now not sufficiently nourished, trained, and developed. For I maintain even today that observation, palpation, percussion, and auscultation occupy a high place in diagnostic procedures. It is particularly in abdominal disease that the physical examination should be complete. The abdomen is a sort of loud speaker for many extra-abdominal disorders. It is a well-known fact that pleurisy, pneumonia, pulmonary tuberculosis, endocarditis, cerebrospinal syphilis, and a number of other diseases may be ushered in with abdominal symptoms. Differentiation of such conditions from genuine abdominal disorders can nearly

always be made by a thorough examination, particularly in case of the last named, by examination of the reflexes, the presence of tremor and the like.

In disease of the female pelvis one is often led astray by the presence of symptoms of indigestion nausea vomiting belching, etc., so that a pelvic examination is nearly always in order. Rectal examination likewise should be a part of the physical examination in both sexes.

A proper interpretation of the history together with the results of a complete and careful physical examination are, as a rule, sufficient guides to the correct path of diagnosis. But it would be about as unwise today to rely upon these alone without the aid of the laboratory, as it would be to send a messenger boy when a telephone conversation is available or to be ultra-modern to go by automobile when an airplane is at one's disposal, for the laboratory has come to play the great part of confirmation where formerly hesitancy existed. Not only that, but it is by correlation of clinical with laboratory findings that the laboratory is constantly adding to the sum and substance of our knowledge.

And yet we must use considerable judgment in the interpretation of laboratory findings. Unfortunately many of the tests which are designed to assist in diagnosis are not of as much value as their enthusiastic supporters claim for them, and are often more impressive to the laity than of value to the surgeon. There is no doubt that the fractional test meal is of more value than the simple test meal which formerly enjoyed more extended use, but the acidity of the gastric contents deviates so often from the expected that it has little value as a guide. We cannot as yet specify what sort of curve for gastric acidity is entirely normal. Our experience with fractional test-meals as checked by operative findings in many hundreds of cases, can lead to nothing but the general conclusion that both in the absence and the presence of anatomic change in the upper abdomen the acidity may be low, moderate, or high. As an example, the free and total acidity were within the "normal limits" in 25 per cent of our cases of gastric and

duodenal ulcers, while in 13 per cent. there was subacidity. In disease of the gall-bladder our figures show almost equal percentages for hyperacidity, subacidity, and normal acidity. This is to be expected considering the numerous factors of error creeping into determinations such as these. The finding of occult blood, either in the stomach contents or in the feces, is another very uncertain aid for the same reasons.

Of more value to us is the leukocytic count, in fact, a complete blood-count is an essential routine procedure on all surgical patients. Diagnostically, a complete blood-count reveals the presence or absence of anemia, a question of considerable importance in certain cases. The balance in favor of operation has been swung by the finding of anemia and high leukocytosis in a number of cases of doubtful ruptured ectopic pregnancies. This refers particularly to those in which the bleeding has not been rapid, but in which the symptoms have been spread out over a period of a week or ten days. In septic conditions the leukocytic count is very often a reliable adjunct, but attention must be called to the fact that a leukocytosis of high degree is not apt to be manifested when a septic process is well walled off, and the body as a whole does not take part in the reaction. We have seen enormous abscesses originating from appendicitis in which the patient's leukocyte count has been normal or practically so. These abscesses were walled off quite securely, and diagnosis depended upon what has already been mentioned as exquisite tenderness and other signs, such as hindrance to respiration, and so on. But when all other signs fail the leukocytosis does occasionally warn us that trouble is present. We have in mind a recent case of a man aged thirty who came to operation for acute appendicitis. His appendix was enlarged, stiffened, and congested. Its peritoneal surface was dulled, and there was considerable exudate in the meso-appendix. No drainage was instituted. Recovery was uneventful for a period of five or six days, when a slight degree of fever warned us that all was not well. The leukocytosis reached 20,000. There were no subjective symptoms of any kind present, and the most careful physical examinations, repeated a number

of times per day, failed to elicit any objective symptoms whatever. The patient declared that he felt perfectly well, his appetite was good, and his other functions were working satisfactorily. Three weeks later, on persistence of the high temperature and the high leukocytosis, he suddenly developed severe pain in the right hypochondrium. The second operation revealed an acute suppurative cholecystitis. Unfortunately, as ceding infection of the liver was present. The patient quickly became jaundiced, but, happily, he made a good recovery. The danger signals he flew were only two—slight fever and a persistent high leukocytosis. Diagnostically, therefore, a blood count is of great value, but it must be regarded with due consideration for other factors in the case.

When the pathologist reports that there are plasmodium malariae in the blood of the patient, that patient unequivocally has malaria. Since there is no reason why a patient with malaria cannot have acute appendicitis as well, we were once saved much worry by finding these organisms in a patient's blood after he had run an atypical malarial temperature following operation for acute suppurative appendicitis. Our instinctive diagnosis in such cases is usually secondary abscess or a similar complication but the microscope revealed the true course of events, and quinin put an end to his disease.

From the standpoint of judgment the laboratory is an invaluable (we might make it stronger and say indispensable) aid to the surgeon. Its usefulness lies both in specific cases and in generalizations. In the case of each individual patient the question of the factor of safety for operation should be considered. We all know that anesthesia alone is a procedure sufficient to place certain individuals in grave danger. From the standpoint of the surgeon the excretory system very often renders an otherwise rational and successful procedure disastrous. It is our practice routinely to examine the functional ability of the kidneys. This we do by means of the phenolsulphonephthalein elimination estimation and quantitative determination of the blood urea. Of the tests proposed for the excretory ability of the kidneys we have found that these two are as reliable as

any others. They check each other remarkably well, and in the few exceptions in which they do not do so, we think twice before undertaking a major operation. By these tests, in conjunction with an ordinary urinary examination, we are able to forestall kidney complications, and often, when these tests indicate poor functional ability, we allow the patient to remain in bed under treatment for some length of time before undertaking an operation.

In diabetes the laboratory is the keystone of the arch of treatment. On the knowledge derived from the blood-sugar and urinary sugar determinations, and an occasional blood bicarbonate estimation and with proper diet, we are enabled to operate upon these patients with as good hope of success as on non-diabetics. The advent of insulin, as Allen says, while it has not simplified our treatment of diabetes, has most certainly placed a very powerful tool for its management in our hands.

From the general standpoint the laboratory is indispensable, providing as it does accurate and definite knowledge in the fundamental branches upon which all diagnoses rest. This refers to anatomy, which has already been emphasized, pathology, bacteriology, and physiology. What shortcomings would our diagnostic logic have were it not for the facts supplied through the laboratory in these branches? Of course, the word "laboratory" in this connection is used in its broad sense. Take, for example, the case already referred to; when our patient developed a septic temperature and jaundice, the knowledge derived from the anatomic relations, the bacteriologic possibilities, and the pathologic study enabled us to make our diagnosis almost with certainty. We know when we operate upon a patient whose meso-appendix has been seriously involved that the possibility of ascending pyelophlebitis via the portal system looms as a large factor in the postoperative course of the case. The facts gained by much toil in the physiologic laboratory when applied to patients enable us to interpret the signs and symptoms, let us say, of gastric disease. To put it tersely, he is the best diagnostician who can combine his twos and twos and calculate the total. His deduction of what are twos and not one

and a half or two and a half, may be said to have been derived in considerable part from the laboratory. We might digress from our main theme to speak of the shortcomings of our knowledge, of its lack and its meagerness in many conditions, and dwell upon the necessity for constant and ever increasing research but it is sufficient simply to remind you of its importance for the future of the individuals who come under the care of our profession.

#### ESSENTIALS OF OPERATIVE DIAGNOSIS

In operative diagnosis the essentials are a knowledge of the abdominal viscera structural and topographic their morbid anatomy living pathologic anatomy and surgical physiology. We all appreciate how difficult or comparatively easy an operation may be depending upon this knowledge. As an illustration let us cite the removal of an appendix not the seat of extensive pathology. How often do surgeons consume a lot of time and perspire freely in doing such an operation. On the other hand recognition of the cecum lifting it into the wound and identifying the ileocolic and ileocecal folds at once, enables the operator to follow the latter to the meso appendix and the appendix. The appendix may be buried in either the ileocecal or subcecal fossa and when in the latter if the margins of the orifice of the fossa are adherent to the base of the appendix at the junction with the cecum, it may be overlooked entirely. Confusion also may arise when the appendix is retrocecal or retrocolic and covered by a pathologic sheet of peritoneum.

Anatomic landmarks particularly in the presence of a clear horizon, should make recognition very clear, and in the presence of a foggy atmosphere give confidence and help which facilitates operative procedure and, therefore makes it safer. A knowledge of dead house pathology is the foundation for the subsequent structure of living pathology. But the modern tendency seems to be to acquire anatomic knowledge exclusively from the living in place of the dead subject, this will not in any way be of advantage to the patient.

In the diagnosis of a lesion with the abdominal cavity wide

open, difficulties are met with, and without a good working knowledge of dead-house and operating-room pathology and surgical physiology some of these difficulties cannot be satisfactorily cleared up.

Indeed, it is not always easy with the abdomen open to verify the preoperative diagnosis, assuming this to be correct; nor is it always easy to make the correct pathologic diagnosis if it has not previously been made. The essentials in both are the proper exposure and recognition of the organs or tissues involved, with the minimum amount of traumatism. This sounds well, but to do it well is another matter. The most common conditions in the upper abdomen that are symptom producing are disease of the gall-bladder, of the duodenum, the stomach, the pancreas, the liver, the spleen, the kidneys, the upper jejunum, the duodenaljejunal junction, and the retroperitoneal tissues. Let us consider only the more common of these diseases.

In the upper right abdomen the most common lesion is disease of the gall-bladder, with next in frequency disease of an appendix in a high position. The essentials in the operative diagnosis of either are good exposure and a knowledge of the pathology of both. Pericholecystic adhesions, as a rule, mean a diseased gall-bladder, but not always. Inflammation of an appendix in a high position causes a peritonitis that does not always resolve, and in such instances sheets of pathologic peritoneum are left which in time become attenuated and thinned out, and form adhesions which can be identified with the particular organ responsible for their formation only by exposure and careful examination. In the preoperative diagnosis one condition is frequently confused with the other, as we have many times proved at the autopsy *in vivo*. A not uncommon x-ray diagnosis is a pylorus in a high position and adhesions. This of itself means little, but it is frequently interpreted as suggesting disease of the duodenum, especially if deformity of the duodenum is also included in the x-ray diagnosis. In my experience these findings indicate pathology either of the gall-bladder or of the appendix. I find that a non-perforated duo-

denal or prepyloric gastric ulcer does not, with very few exceptions cause periduodenal or perigastric adhesions

In the operative diagnosis also of the liver, the hepatic duct, the common bile duct the pancreas, and the gall bladder good exposure is essential in order carefully to inspect and palpate. In the case of the biliary ducts palpation and inspection alone will not always suffice, as, for example, in the presence of stricture or of a stone in the common duct in relation with the pancreas or the walls of the duodenum, here incision into the duct and instrumentation must be added to inspection and palpation. The diagnosis of certain forms of jaundice, as well as pancreatic lymphangitis of chronic pancreatitis, and retro peritoneal pathology can be made certain only by this method. Duodenal drainage by means of the Lyon method or the Ein horn duodenal bucket are not by any means infallible.

The preoperative diagnosis of ulcer is confirmed or disproved by operative inspection and palpation, and in a few cases with incision through the anterior wall of the stomach and wide retraction. The latter is occasionally necessary for diagnosing a possible marginal gastrojejunal ulcer. With the interior of the stomach exposed through an incision in the anterior wall the stoma of a gastroenterostomy can be readily brought into view and carefully inspected and palpated. The x ray diagnosis of a duodenal diverticulum, of duodenojejunal and jejunal carcinoma, as well as a lesion of the intestinal wall elsewhere can be verified only by opening the abdomen.

It is not necessary to go any further into the detail of other lesions either in the abdomen proper or the pelvis to prove these essentials.

If we are careful to correlate all the essentials in surgical diagnosis we will seldom go astray.

The laboratory in operative diagnosis can be a distinct aid. First and foremost are the results obtained by the frozen section examination of tumors removed at operation. We have said that knowledge of morbid anatomy is essential to operative diagnosis. With this knowledge it is of course, possible for the surgeon at least to distinguish grossly between malignant and benign

reveal a fecal impaction when least suspected by the intern and the nurses. Again, how often will the passing of a catheter and the withdrawal of a large amount of urine dispel a mystery in the shape of a hypogastric tumor.

The more common complications after operation include shock, hemorrhage, cardiac weakness with tachycardia, peritonitis, mechanical intestinal obstruction, paralytic ileus, secondary collection, and, during convalescence, pulmonary embolism and acute cardiac dilatation.

While it is true shock after surgical operation is now seldom seen, it occasionally occurs. The essential points in its recognition are the rapid and compressible pulse, the extreme weakness and apathetic state of the patient, the relaxed skin, the low temperature, and the low blood-pressure. It may occur before the operation is completed. Occasionally shock is delayed for a short time after operation, but it does not differ symptomatically from that occurring during or immediately after operation.

Internal hemorrhage is recognized by the blanched appearance of the patient, restlessness, the rapid, small, compressible pulse, air-hunger, and thirst. It is not always perfectly clear whether the patient is only shocked or is bleeding as well. The diagnosis can often be made after intravenous salt infusion which with few exceptions immediately brings up and maintains the pulse in shock, but not when the patient is bleeding; a complete blood-count is essential. Here lies the importance of routine blood-counts, for we never can surely tell which patient will and which will not bleed. Cardiac weakness with tachycardia clouds the picture, and unfortunately we do not get the comfort from administering the different cardiac stimulants we hope for, this is particularly true of digitalis, nor should we expect to get an immediate effect from this drug. I derive greater comfort in giving morphin and a small amount of salt solution into the vein than with the usually recognized diffusible stimulants, including caffein, pituitrin, camphorated oil, etc. When I was a hospital intern whisky and ether were given, and I still occasionally adhere to a habit of my youthful days.

Peritonitis occasionally follows operation or is aggravated

by it. The essential points in the diagnosis are nausea, soon followed by vomiting, pain and tenderness with greatly diminished or entire absence of peristalsis over the area of most intense inflammation, rigidity of the abdominal wall at the same site, soon followed by distention, elevation of temperature, increased pulse, increased abdominal tension, and inability to pass flatus.

When peritonitis is well advanced, the picture consists of paralytic ileus with regurgitation of the contents of the upper small intestine, uniform distention of the abdomen, inability to pass gas, tinkling upon auscultation, and loud pulsation of the aorta. Accompanying these signs are a bright eye and an active brain and not infrequently superficial cyanosis. The patient does not usually realize the gravity of his condition.

Intestinal obstruction, either of the slow or the rapidly forming type, more often the former, causes at first intermittent cramp like pains, immediately followed by nausea and later by vomiting hyperperistalsis and inability to pass gas. When the abdomen has been opened in the presence of infection mechanical obstruction may occur without giving the classical symptoms. The diagnosis can be made on the absence of fever, a rapid, weak pulse, the presence of great distention without marked tenderness, the absence of peristalsis, accentuated pulsation of the aorta, and either vomiting or regurgitation of dark material with a fecal odor. Lavage will wash out large quantities of the same material and no matter how often repeated the same result will be obtained. If lavage is not followed by reduction of abdominal distention and cessation of the vomiting, the abdomen should immediately be opened.

A perplexing condition is secondary abscess, often associated with complete obstruction, for which operation is the only solution. We have learned by experience that localized tenderness, distention, fever, with peristalsis present, are the cardinal signs of secondary abscess, and that these abscesses show a preference for certain situations namely, at the site of or in the immediate vicinity of the original operation in the pelvis, behind the cecum and colon in the subhepatic space, and between the dia-

phragm and liver. Occasionally a secondary abscess is centrally located. In the diagnosis of subdiaphragmatic collections the x-ray is of great value in determining immobility of the diaphragm in the presence of a collection immediately beneath it.

Infection of the incision can usually be easily recognized by the absence of marked general reaction, the presence of tenderness, fulness, etc., the signs of inflammation in the wound itself, plus, oftentimes, great abdominal distention.

The diagnosis of postoperative pneumonia is also one which usually affords little difficulty. The reaction of the patient includes rapid and labored respiration, together with the physical signs of consolidation which may, however, delay their appearance for several days. The question of differential diagnosis between what might be called pure bronchopneumonia and a pneumonitis in localized areas following the transport of infected emboli, is often one hard to determine, and frequently the distinction must be postponed until quite late in the disease.

The laboratory is of value to us in the diagnosis of all these postoperative conditions. Our first thought is directed toward the blood-count. In cases of hemorrhage the comparison between the postoperative and the preoperative count is worth all of the previous routine work in order to have this index of comparison ready when the occasion demands. The leukocytic count also quite frequently tells us of the presence or absence of infectious processes with the aforementioned limitations.

As to bacteriology, the usefulness of cultures and smears from our glass tubes can be extended to wounds, and oftentimes we have had occasion to prepare autogenous vaccines. We believe that in certain cases the results have justified their use. The results of smears made during operation indicate what to expect after operation and enable us to give the friends of the patient a more definite prognosis.

Although acidosis does not play the part in surgery that was ascribed to it some years ago, yet in a certain number of instances it is an added burden to an already overtaxed organism endeavoring to recover. By means of determinations of the bicarbonate content of the blood we not only are enabled to determine the

presence and degree of acidosis, but can actually calculate the necessary dosage of alkali to restore the acid-base function of the body to a normal level. In diabetes the laboratory is of course a first aid in the postoperative management of such patients.

Accurate pathologic descriptions and reports of tissue removed at operation are of course indispensable. In many cases they establish the diagnosis, they determine the future mode of treatment, especially in tumors, but no less so in certain other types of disease. We might mention as an example tuberculous salpingitis. This condition is by no means uncommon. Naturally it requires a different line of treatment than the ordinary acute or chronic suppurative conditions. A careful pathologic examination with the help of the microscope is often the only way of positively determining the early presence of this specific infection in these and other organs.

Such a simple thing as an ordinary urinary analysis may be the pivot around which postoperative therapy revolves. In the case of pyonephrosis and cystitis when the offending kidney is removed we expect the cystitis to disappear. The urinary analysis determines the diminution in the quantity of pus as the pathologic process is overcome.

Finally, from the standpoint of research our operative procedures have oftentimes given the stimulus to the laboratory to investigate functions of various organs of the body when they are placed in other relationships. Fortunately, advantage has been taken of many such opportunities and the benefit has been mutual. Not only has the surgeon in this way been a stimulus to the laboratory worker, but the laboratory worker has, in his turn, unearthed facts in the physiology of the various organs which have reacted to the benefit of the surgeon and, thus, directly to the patient. By this team work, therefore, much valuable knowledge has been gained. Let us hope that this co-operation will continue. The benefits derived from it will most surely make themselves felt in the better interpretation of what our trained senses tell us, in better and more accurate aids to our senses and better and more comprehensive help to our patients.



## CLINIC OF DR. GEORGE P. MULLER

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#### SURGERY IN DIABETICS\*

THE relation of diabetes to diseases requiring surgical intervention is attracting increasing interest, especially now, when the discovery of insulin offers a means of controlling coma, the cause of death in nearly 80 per cent of the mortality. Fitz, in a series of 385 diabetic patients consecutively treated at the Massachusetts General Hospital, found that 14 per cent. required surgical treatment Joslin writes that of 903 cases, at least 11 per cent required surgical aid.

Most surgeons fear operations on the diabetic, many never operate except in grave emergency, and yet, thirty years ago, certain English surgeons—Spencer, Godlee, Wallace—boldly advocated early amputation as a means of reducing the glycosuria.

Among the best of the early studies on this subject must be mentioned those by Smith and Durham (1892) and by Phillips (1902). The latter gives a complete bibliography up to that time. In this lecture I will refer mostly to certain papers published during the last two years and illustrate with the cases I have seen since July 1, 1922

It is not my province in this lecture to explain the cause of diabetes. The mechanism regulating the amount of sugar in the blood is very complicated and seems to concern four ductless glands—the suprarenal, thyroid, pituitary, and the pancreas.

Adrenalin probably acts by converting the glycogen of the liver into sugar or by causing an increase in the amount of glycogen in the liver through mobilization of the sugar in the muscles. Not so much is known regarding the action of the thyroid gland. Sugar tolerance may be much reduced in exophthal-

\* From the Surgical Division, University of Pennsylvania Clinical lecture delivered to class in "Insulin in Diabetes"

mic goiter, and this fact has been used in the endeavor to find a test for this disease. It has long been known that the pancreas, and particularly the islands of Langerhans, is intimately related to diabetes. The mechanism at work in the etiology is still very obscure and the true cause awaits discovery. Obesity, heredity, age, infections, and a nervous element are factors. As Joslin puts it, diabetes is largely a penalty of obesity.

Willy Meyer studied 15 cases of Buerger's disease, all in Russian Jews, and found that the sugar tolerance test was followed by a blood-sugar concentration, varying between 0.138 and 0.248. Accordingly, he considers them as suffering from *glycophilia*, a condition midway between the normal and the diabetic. This point is related to an investigation by Morrison and Ohler, who studied blood-sugar curves in Jewish and non-Jewish patients with no apparent glycogenic disturbance. The incidence of high curves was the same in both groups, and they conclude that as all the high blood-sugar curves in the Jewish group occurred in individuals with a nervous or emotional temperament, this may be significant in the explanation of the prevalence of diabetes mellitus among Jews.

Many writers have distinguished between glycosuria and true diabetes mellitus, but in a patient requiring operation "the presence of glucose in the urine, whatever its amount, is always a serious fact" (Verneuil, 1884). No doubt *diabetes innocens* does exist, and represents, to use the words of Graham, the leaking of sugar with a normal blood-sugar, the response to a sugar tolerance test being no greater than that of a normal individual to a similar dose. Glycosuria is undoubtedly frequent in many of the common surgical infections, transient and disappearing when the local lesion is healed. It may be of some value to call your attention to the grouping of Phillips modified from Smith and Durham. He distinguishes (1) those cases in which glycosuria is caused by the surgical lesion; (2) those cases in which it causes the surgical lesion, (3) those cases in which the two are independent and do not influence each other; (4) those cases in which glycosuria exerts a baneful influence upon the other disease or injury. However useful this classification

may be for purposes of study, I do not think that it or any similar classification is helpful in recognizing or treating diabetes associated with a surgical lesion. It is well known now that mild diabetes may be successfully operated on and I might illustrate this point by this patient.

**Case I—A T Female Age forty nine Referred by Dr E V Clark Admitted to University Hospital September 30, 1923 Discharged October 23 1923 recovered**

Two years previously was in this hospital with umbilical hernia and at that time sugar was detected in the urine. Operation refused. Twenty four hours previously the hernia incarcerated and patient admitted acutely ill with the usual symptoms of obstructed bowel. Sugar acetone and diacetic acid present in the urine. The breath smelled strongly of acid. She was slightly comatose. Under local anesthesia immediately after admission Dr Ravdin operated successfully removing omentum and sac. At the conclusion of the operation the stomach was well washed out and 500 c.c. of glucose solution (5 per cent) given intravenously.

We were interested to note that forty eight hours later the blood sugar was 0.250 per cent but the plasma CO<sub>2</sub> was 69 volumes per cent. The patient had been getting soda per rectum. On October 14th the urine was negative for sugar and the acids. On discharge was given proper dietary instructions. On August 5, 1923 ten months later she was well, had no trouble with the scar and had stopped the antidiabetic regimen.

Diabetes is commonly associated with gall stones, presumably because the lymphatic connections allow the development of pancreatitis which may affect the "islets." Generally it is of mild type and there is no reason why operation should not be performed. The association of liver disease with diabetes is much rarer hence it is the infection that is of importance. I do not think that any of the recent cases of gall stone disease on my service had glycosuria certainly none of the fatalities were glycosuric although 2 died of the pancreatic asthenia described recently by Whipple. We did have one patient with the

associated phenomena, but the diagnosis was not confirmed by operation.

**Case II.—M. F. (N. S. 1016).** Female. Age fifty-four. Referred by Dr. Orloff. Five weeks previously had the "flu," and shortly thereafter suffered with epigastric distress and belching after meals. On the day of admission (March 14, 1923) she suffered an attack of biliary colic, for which she was admitted; there was no jaundice. Routine urinalysis showed the presence of acetone, but no sugar, but the blood-sugar was 0.214. She was transferred to the Medical Service, remained one month, was diagnosed as cholelithiasis with mild diabetes, refused operation, and was discharged on a diet. She has remained well.

At least 2 cases of acute appendicitis had associated diabetes, one recovered and one died, but time does not permit the details.

These statements open up the general question as to whether operation should be performed on diabetics except as a matter of necessity. In other words, can a patient with gall-stones, hypertrophied prostate, simple hernia, fibroid of the uterus, etc., undergo operation without undue risk. Joslin records that, omitting carbuncle and gangrene, he has records of 27 patients operated on up to 1917 with 5 deaths, a mortality of 18 per cent. Since 1919 there have been 61 operations, with a mortality of 9 per cent. Fitz notes the result of 45 operations at the Massachusetts General Hospital for 1913-1917. In one group of 20 cases with acute infection or gangrene the mortality was 50 per cent.; in a second group of 25 non-infected cases the mortality was 12 per cent.

For the five years (1918-1922) at the same institution Young states that of 99 cases, 16 died, a mortality of 16 per cent. The mortality in the collection of cases recorded by Phillips in 1902 was 25 per cent. From these few figures, and there are others, it is apparent that the diabetic has almost as good a chance from operation as the non-diabetic except in the presence of sepsis. Karelowski's figures are often quoted in this connection: 11.8 per cent. of 68 patients with diabetes died after operations

on non infected tissue, and 21.7 per cent of 69 patients died after operation on infected tissues

The factors of importance in obtaining a low mortality are  
(a) the preparation of the patient (b) anesthesia, (c) postoperative treatment

We must first remember that the diabetic is usually an elderly, stout person with impaired resistance the kind that are not considered first class risks even in the non diabetic. The cardiovascular apparatus is invariably impaired and the proper remedial measures instituted. Digitalis should be administered in intensive doses unless contraindicated. Attention should then be directed to the kidney function and the usual tests performed to estimate it. It should be remembered that glycosuria may be absent with a high blood sugar, the high renal threshold usually indicating a more serious prognosis. Proper eliminative measures must be taken and the intake and output measured. Alkalies are particularly dangerous when the kidneys are diseased.

Remembering the neurotic factor in many of these patients the surgeon will do well as suggested by Addis to avoid and alleviate mental disturbances fear of operation etc., by employing to some extent the *anociation* methods of Crile.

Finally the adjustment of the diet is of supreme importance. You will hear of this elsewhere and will do well to bear in mind that the complete withholding of carbohydrates is indefensible. The patient simply needs that diet which brings him to the point where he reaches the point of carbohydrate tolerance. The urine should be free of acid and practically from sugar. Orange juice, white of egg and oatmeal gruel seem to be the favorites early, followed by the 5 per cent vegetables. The surgeon should always interest his medical confrere in this aspect and also the laboratory expert because it is the latter who checks the progress by this estimation of the blood sugar and plasma CO<sub>2</sub> as well as the ordinary urinalysis. Foster says that when the blood sugar is higher than 0.35 per cent, or the CO combining power of the plasma is less than 40 volume per cent at the time of operation a fatality is probable. 'The only safety in cases of this type is to change the metabolic state prior to treatment. If

there is not time to do this the case is hopeless." Some exception has been taken to this opinion, but it serves as a safe rule.

It is difficult for me to evaluate the value of alkalies in the preparation of these patients. Formerly I used sodium bicarbonate in doses sufficient to alkalinize the urine, but latterly, influenced by a number of authorities, have abandoned it except in moderate doses. I am afraid of sodium bicarbonate (3 per cent) intravenously. Despite reports such as those of Cary, patients may be sent into coma by the careless use of sodium bicarbonate. Kahn states that he "has never seen a case of diabetic intoxication that was saved by the administration of the bicarbonate. Frequently, the acetone substance lies dormant in the tissues of the body, in union with some protein or amino-acid group. The sudden flushing of the system with the sodium bicarbonate serves to split off the ketone substances, with the immediate overwhelming of the vital centers."

Insulin, before operation, must be given with every safeguard taught by authority. At the present time we are entirely governed by the advice from Dr. Jonas of the medical group. As you will hear, it is given cautiously before meals until the urine is sugar free. It acts by promoting the burning of carbohydrate, hence the patient must be taking sufficient carbohydrate to act as fuel. A proper balancing of carbohydrate intake and insulin will, I am sure, enable us in the future to operate on diabetics with almost the same freedom as on normal individuals.

The anesthetic is of paramount importance, ether injuriously affects the liver and body fats just as does chloroform, only to a less extent. It should never be used in diabetics. Local anesthesia predisposes to extensive necrosis if infection occurs. This leaves us nitrous-oxid-oxygen as the anesthetic of choice, with spinal anesthesia as the best anesthetic for operations on the extremities and pelvis. In Young's series ether was used 33 times in 86 operations. Ten patients that did not die showed an increase of sugar in the urine or blood, or both, and an increase in the excretion of acids. Of these 10 cases, 8 had ether as an anesthetic.

Many of you no doubt believe that the diabetic is especially prone to infection and that such infected wounds heal with difficulty. But this is only partly true. Sugar probably increases the pus producing properties of micro organisms, but not their virulence. The tissues are low in vitality because of the vascular degeneration. Hence, if roughly handled, they respond readily to the entrance of infection but, if properly treated, such wounds respond readily. In 3 cases of diabetic gangrene I had much trouble with the stumps, but the wounds made to perform sympathectomy on the femoral artery in Scarpa's triangle all healed perfectly. Hence rapid, clean, dry surgery is imperative.

The postoperative treatment is merely a continuance of the preoperative, with this exception. Coma may readily occur if the balance is easily upset. The patient must be watched hourly, and the surgeon ready to use insulin and glucose intravenously if coma threatens. The plasma CO<sub>2</sub> is of great use as an indicator. Water should be given early, and oatmeal gruel begun at the same time. We start hypodermoclysis on the operating table and continue it until the patient is ingesting water freely. The stay in bed should be materially shortened and the patient taught to exercise in bed.

Coma is due to the development of acid or ketone bodies, beta oxybutyric, diacetic, and acetone. The combustion of carbohydrates fails and "the fat smokes."

Karewski reports that he has operated on 136 diabetic patients, with a mortality of 20 per cent, of which 78 per cent died in coma, 50 per cent of his cases with coma were patients with mild diabetes. Joslin found that coma was the cause of death in 66 per cent of the total deaths in his patients up to 1915. But between April, 1919 and July, 1923 21 per cent of the deaths were from coma. Foster states that until the last year he had not seen a complete recovery from diabetic coma, whereas, during the last year of 15 cases treated with insulin, 5 made a complete recovery.

Finally, what shall we say about the operations of necessity? The patient with acute appendicitis, perforated ulcer, ruptured

extra-uterine pregnancy, etc., must be operated on without regard to the diabetes. In fact, in most cases, the existence of hyperglycemia will not be known unless the surgeon insists on a routine urinalysis before operation in every case. If known, the operation should be carried out with the precautions mentioned in the preceding, minus the preoperative dieting, and every effort made to reduce the acidosis after operation. Here insulin will prove a great boon. A suggestive study by Thalheimer shows that not only diabetic but also non-diabetic acidosis may be successfully treated with insulin. In 3 cases vomiting and ketosis was almost immediately checked by insulin and intravenous glucose solution.

But the most important operations of necessity, as you will find, are those for gangrene of the lower extremity, carbuncle, and cellulitis. These are so important that they should be considered separately.

**Gangrene.**—Next to coma, this is the most important complication. Morrison found it to be a contributory cause of death in 23 per cent. of 775 fatal cases of diabetes in Boston during the years 1895 to 1913.

Generally speaking, gangrene is a late complication of diabetes, and is almost invariably associated with an arteriosclerosis similar to the ordinary senile form. The glycosuria may be an antecedent or a secondary condition. The roentgenogram gives valuable evidence of the presence or absence of calcareous arteries. The importance of this endarteritis obliterans was pointed out by Heidenhain (1891), and it is significant that gangrene is extremely rare in young diabetics. In the collected cases reported by Smith and Durham the minimum age was forty. Gangrene usually occurs in old diabetics or else the presence of sugar is not suspected until the examination made preliminary to amputation. In many patients the glycosuria promptly clears up after amputation and healing. This patient is an example.

**Case III.**—Mrs. S. (N. S. 1259) was admitted to my service in the University Hospital April 27, 1923. Referred by Dr.

Platt Five years previously sugar was detected in the urine and she was treated for diabetes in the Pennsylvania Hospital She improved and under diet remained well until the winter of 1921-22 when an abscess formed behind the left ear She recovered under treatment

In October, 1922 the left foot became painful and swollen After a month or so the big toe became gangrenous The gangrene gradually extended until on admission it had involved the entire foot She suffered from thirst, polyuria weakness, and the loss of weight

There was sugar in the urine, blood sugar 0 214, plasma CO<sub>2</sub> 58 volumes per cent

Amputation performed through the middle of the leg (April 28 1923) under gas anesthesia On discharge (June 10, 1923) the wound was healed, the urine was sugar free September 1, 1923 Dr Platt reported that she was well and constantly improving

In his discussion on the normal flow of the blood Macleod states that in diabetic gangrene of the feet there is a very subnormal flow in both the hands and feet The vasomotor reflexes are also feeble Now, if the diabetic patient with marked endarteritis obliterans has a deficient supply of abnormal blood trickling through the capillaries of the extremities, it follows that any local infection will precipitate the gangrene Infection is followed by the defensive mechanism of inflammation with serous and cellular exudate, and this pinches still further the blood supply, with consequent necrosis and tissue death Probably the direction of spread of the infection determines whether a toe artery is obstructed with resulting gangrene, or tissue necrosis on the dorsum of the foot spreads around and in the tendon sheath, with abscess formation steadily burrowing The practical lesson to be drawn is a warning to the diabetic to avoid careless treatment of blisters corns etc Sometimes the early lesion resembles the trophic ulcer and probably is dependent upon a similar nerve degeneration for its cause Smith and Durham collected 24 cases of this type

The gangrenous foot should be amputated early, there is

almost always a hopeless endarteritis with obliteration, and time, money, and mortality are saved by early operation. A few days are all that is required to study the laboratory reactions and prepare the patient by diabetic measures—free use of water and digitalization. Ten years ago Stetten found the mortality to be “appalling” and advocated conservative treatment; 17 cases were reported, with a mortality of 29 per cent.

Joslin states that of 25 patients, 7 died after operation, and he reports some figures by Binney from the Boston City Hospital, showing 19 deaths in 32 patients. Young, reporting from the Massachusetts General Hospital, had 4 deaths after 12 amputations. Jones, of Providence, reports that of 8 amputations, one recovered. I have not included toe amputations. Now, if we summarize these 4 reports, we have 77 cases with 37 deaths, or a mortality of 48 per cent. This seems too high, and I would judge either that the diabetes was too severe for control or that delay had allowed sepsis to predominate and destroy the patient. Stetten’s remarks are, therefore, worth reviewing, and I will do this later.

Some years ago Dr Kern collected a consecutive series of amputations performed in the University Hospital. Amputation through the leg was performed on 11 patients, with 4 deaths, and through the thigh on 10 patients, with 3 deaths, a total mortality of 33 per cent. The ultimate result in the high amputation was very much better than in the low.

This emphasizes the necessity for extreme caution in deciding the place where amputation must be performed. Gussenbauer (1905) taught that amputation must always be done above the knee in case of doubt or if the pulse could not be felt in the popliteal space. If the dorsalis pedis pulse was present, local removal of the diseased part might suffice. The following case illustrates the bad results of conservatism:

**Case IV.**—W. W (N S 1542), a negro male, aged fifty, was transferred from the Pepper Ward suffering with gangrene of both feet, involving apparently only the toes. On April 7, 1923, under spinal anesthesia, the ends of both feet were amputated

behind the metatarsophalangeal articulation. The flaps were left open.

Under ordinary circumstances such an operation is indefensible, but here lines of demarcation had apparently formed and the dorsum looked quite healthy. The wound failed to heal well and pain was experienced. Partly to relieve the pain and partly in the hope of improving the peripheral circulation I did a *periarterial sympathectomy* on the right femoral April 19th, under local anesthesia. No improvement was noted. On April 28th both legs were amputated above the knees under local anesthesia. Infection and necrosis of tissue continued up the thigh tissue planes and required further operating on May 29th to get drainage. Death occurred in coma on June 15th.

This patient was under the constant control of Dr. Jones, who by diet and insulin had his diabetes well in hand at all times. At one time (June 2d) he developed coma with a blood-sugar of 0.065. Evidently a hypoglycemia had occurred, improvement occurred immediately upon cessation of insulin and the intravenous administration of glucose. The proper course of procedure in this patient would have been a prompt thigh amputation on about April 15th, when we know the foot amputation was unsuccessful.

Another patient illustrating the ill results of conservative treatment is the following:

**Case V—J W (N S 620)** was admitted to my service, University Hospital December 29, 1922. Referred by Dr. Wolferth. For five years he has been under treatment for diabetes. Starting six weeks ago with pain in the heel and toes of the right foot and heel of the left foot. The fourth toe was discolored. There was no dorsalis pedis pulse and a wide spread arteriosclerosis. The breath smelled of acetone.

On December 30th a *periarterial sympathectomy* was performed. Only slight relief and gangrene was precipitated. On January 2, 1923 the toe was amputated and the foot incised, also the patches on the heels were cut out. The gangrenous process extended and the patient grew worse. On January 17th

amputation was done through the thigh under gas anesthesia. He died two days later. During the progressive stage his blood-sugar was 0.202 and the plasma CO<sub>2</sub> was 65 volumes per cent. For this reason he was not given insulin until the day death occurred, when 15 units were injected to note the effect on the coma. Glucose was also administered. The patient became rational for four hours and then relapsed.

Young states that there are two types of diabetic gangrene—one of the arteriosclerotic type, where the operative indication is the same as in the sclerotic cases, the other when the gangrenous process can generally be influenced and often stopped by appropriate dietetic and local treatment. In regard to the latter Stetten advocates hot baths of saline solution twice a day or baking in the hot oven, local treatment with wet saline compresses; excision of the necrotic tissues when the line of demarcation has formed. But I must caution you again that the danger in diabetic gangrene is that of sepsis, and unless this is controlled promptly no time should be lost in amputating.

Many cases of cellulitis in the foot are accompanied by cyanotic appearances suggesting gangrene. Free incision with removal of sloughs and drainage of pus pockets plus diabetic treatment will often result in healthy granulation and healing. If the phalangeal joints are open and infected, amputation of the toe should be done by a simple guillotine method.

Carbuncle has long been considered as a frequent occurrence in the course of diabetes, and I think that most of us usually associate carbuncle with diabetes. I was much surprised, therefore, at the result of an analysis of a consecutive series of 42 cases of carbuncle during six years in the University Hospital. Only 6 patients (14.3 per cent.) were diabetic, and of these, 4 died (66.7 per cent.). There was only one death (2.8 per cent.) in the non-diabetic group. Two of the fatal cases were on my service.

**Case VI.**—Male, aged forty-four. Began three weeks before admission as a pimple, made worse by squeezing. Admitted with a large carbuncle on the neck and shoulder. Had odor of acetone on breath. Leukocytes, 14,600. Sugar, acetone, and diacetic

acid present in the urine. Blood sugar, 0.440, plasma CO<sub>2</sub>, 40 volumes per cent. The carbuncle was excised under gas anesthesia and a 3 per cent solution of sodium bicarbonate given intravenously. The same drug was given freely by mouth. He died in four days in coma. This was in 1920, before the days of insulin. There was but little febrile reaction until just before death.

**Case VII**—E. L. (N. S. 76), age forty seven was referred by Dr. Houston, who stated he had always been in good health and free from boils until five weeks previously, when he noted a small lump and swelling on the back of the neck. This developed into a boil, which he treated for three weeks and then had it incised. Did not do well. Admitted to my service August 8, 1922 with a large indurated carbuncle, draining partly through a crucial incision. The urine was found heavy with sugar, blood sugar, 0.332, acetone, a trace, leukocytes, 38,500. On August 12th after preliminary poulticing the carbuncle was excised under gas anesthesia. He did not do well, and on August 18th Dr. Wolferth made the following note: "It would appear that the danger from infection is greater than that of diabetic coma, as the diabetes does not seem to be severe." Under changed treatment he improved and on August 23d he was "much improved and wound healing." On August 30th Dr. Wolferth increased the diet. On September 1st the patient suddenly developed acute pulmonary edema, from which he died in a few hours. Early we were giving alkali, but this had been checked two weeks before death.

The surgical treatment of diabetic carbuncles differs in no way from that in the non-diabetic. Nitrous-oxid-oxygen anesthesia is essential, and to me it seems best to excise the infected area beyond the zone of purulent infiltration and treat the resulting wound with wet packs, kept moist by Dakin's solution. The crucial incision, even after the Kanavel technic, has the disadvantage of leaving much sloughing tissue, and even though tension is relieved there is some absorption. The details of the management of a carbuncle are shown in Figs. 47-50.



Fig. 47.—Excision of carbuncle with either knife or cautery.



Fig. 48.—Voluminous gauze dressing with Carrel tubes inserted to and laid on the raw wound. Installation of Dakin solution at two-hour intervals.

Both of the patients who recovered in the University Hospital series entered the hospital with marked glycosuria, acetone, and diacetic acid; both were operated on by Dr. Wood and left

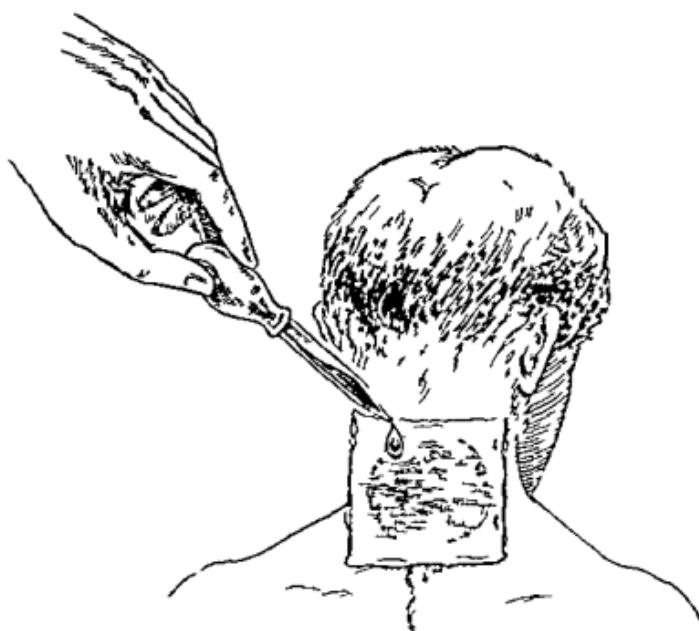


Fig. 49.—After separation of sloughs wound dressed with paraffin mesh and dichloramin T. Sometimes painted with gentian violet solution



Fig. 50.—When free from discharge and clear of bacterial growth, especially streptococci, wound is grafted by Reverdin method

the hospital a few weeks later sugar free and acid free. Smith and Durham state, "It seems not improbable that a consider-

able number of cases of carbuncle that have been attributed to diabetes should rather be considered as cases of carbuncle with secondary and transitory glycosuria." Further, they say, "There is, on the whole, not sufficient evidence to show that the presence of glycosuria has influenced the course of the malady in any way for the worse." But in the very short series observed in this hospital there was a great difference in the mortality between the diabetic carbuncle (66.7 per cent.) and the non-diabetic (2.8 per cent.). Higginson believes that the "sapromic poisoning" from the carbuncle lowers the saturation point for the body and hyperglycemia and glycosuria result. Hence, the necessity for early operation and thorough removal of the necrotic mass. Then, flooding the body with water, digitalization, and skilful diet should prevent the onset of the fatal coma.

Operation was delayed in one of the fatal cases in our series, and another had an associated severe nephritis, always a complication leading to death in the diabetic with carbuncle or gangrene.

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## CLINIC OF DR. MOSES BEHREND

JEWISH AND MT. SINAI HOSPITALS

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### VARIABILITY OF THE SYMPTOMS AND PATHOLOGY OF ACUTE INTESTINAL OBSTRUCTION

IN a general discussion of this subject it is well to remember that rarely do we have all the text-book symptoms present in any single case. If this were so it would be comparatively easy to make a diagnosis in every case at the very inception of the condition. As a matter of fact, the variability of the symptoms are as legion as the pathologic conditions found at operation. While no two cases are exactly alike in symptoms and morphology, there may be present occasionally a symptom, such as pain and vomiting, common to all. Curiously enough, while pain was present in 4 of the 5 cases to be reported, vomiting was only present to a marked degree in 2.

The cases in the order in which they occurred followed each other in rapid succession in the course of four weeks.

They were as follows:

1. A case of volvulus.
2. Thrombosis of the superior mesenteric artery (gangrene of ileum).
3. Diaphragmatic hernia followed, again, by acute intestinal obstruction

4. A gall-stone causing intestinal obstruction.

5. Congenital absence of a portion of the ileum.

1. Volvulus.—In presenting the first case the fact that impressed one most was the absence of serious symptoms in the presence of a serious condition. The patient was a robust man of sixty-five. While he had always been constipated, he had never been ill before. He was taken sick suddenly in the early morning hours of May 26, 1923. He complained of pain

in his abdomen. He vomited once. The abdomen was somewhat distended and the pulse was slow. The following day there was a recession of all the symptoms, the abdomen became soft and flabby and easily palpable. The bowels had moved and flatus had been passed. No mass could be felt, although there was a little fulness in the left flank. The following day

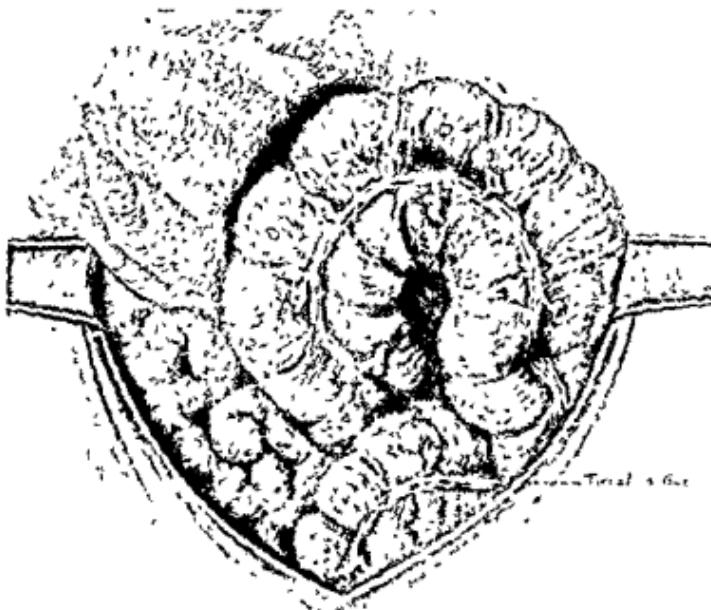


Fig. 51.—A case of volvulus. The colon was greatly distended on either side of the twist in the colon and mesentery

the abdomen became tense again, no gas or feces were passed. The pulse rose a little.

*Diagnosis*—In a patient with the fine physique possessed by this man carcinoma of the sigmoid or descending colon could have been ruled out had it not been for the fact that there was present a long history of constipation. It is always well to bear in mind the possibility of the existence of a carcinoma of the colon or the sigmoid flexure in a patient in whom constipation has been present for a number of years supervened suddenly

by the symptoms of intestinal obstruction. Diverticulitis is always accompanied by a mass and followed by fever and leukocytosis. It is not an uncommon condition at this age. In this case, however, there was no palpable mass. Again, volvulus is considered the most frequent cause of acute intestinal obstruction in those past sixty, but in our experience carcinoma of the descending colon and sigmoid has been the condition most frequently encountered.

It was impossible to make a definite diagnosis of the condition causing the symptoms of the acute obstruction. The various phenomena mentioned above were all duly considered.

*Operation*—When the abdomen was opened under gas anesthesia we found the descending colon was completely twisted on itself with the gut distended above and below the constriction (Fig. 51). As if by magic the contents of the bowel were equalized when the twist was relieved. The descending colon and sigmoid flexure were quite redundant, otherwise a twist of this character could not have occurred. A rectal tube was inserted immediately beyond this point and a large amount of flatus and feces was expelled. The patient made a good recovery.

2. Thrombosis of the Superior Mesenteric Artery.—Patient B. L. Age forty-two. Female. She was an inveterate sufferer from asthma for eighteen years. Admitted to the Mt. Sinai Hospital May 26, 1923, complaining of pain and distention of the abdomen and inability to move the bowels. She did not vomit. For the past two weeks the patient had been complaining of obstinate constipation with an accompanying persistent distention of the abdomen. When first seen in consultation the patient presented a pitiable sight on account of the great distress occasioned in breathing due to asthma which overshadowed the abdominal symptoms. Her face was blue and swollen, the lips were purplish in color, the eyes bulging and injected. She was gasping for breath. All the accessory muscles of respiration were used to obtain air. Palpation of the abdomen revealed great distention and rigidity on account of the accompanying asthma.

The remarkable feature of this case is the fact that she was not operated upon until May 28th, four days after the symptoms of intestinal obstruction began. At first we refused to operate on account of the poor physical condition of the patient, a weak heart superimposed on shattered lungs. Forty-eight hours after

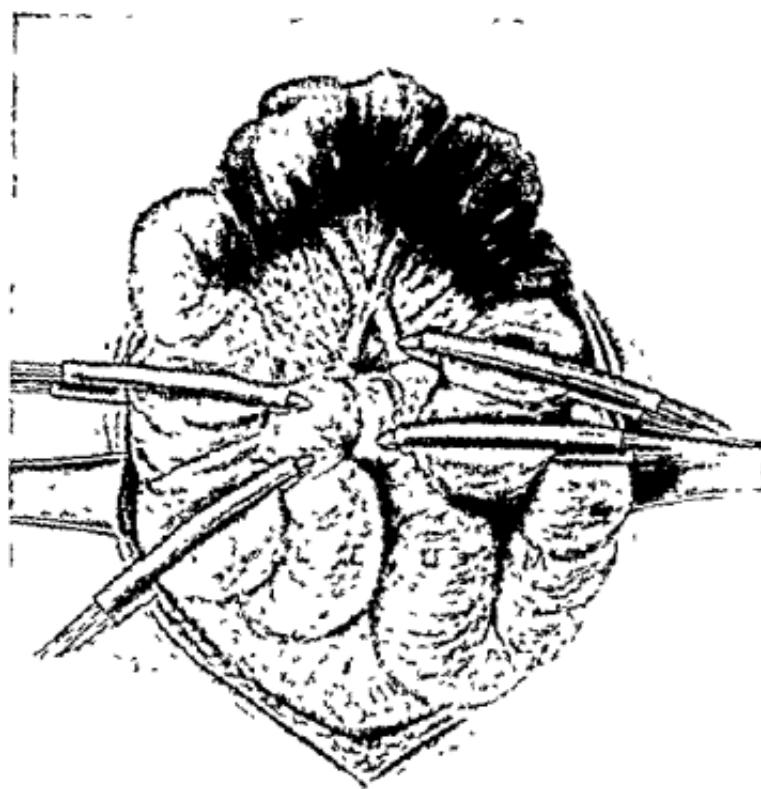


Fig. 52.—Thrombosis of the superior mesenteric artery. Gangrene of a large portion of the ileum. Note the small thrombi in the small blood-vessels, the *intestini tenuis*.

her admission to the hospital the pulse, which had been very weak, seemed to improve, though the abdominal and chest signs and symptoms remained the same. During all this time there was no vomiting, but obstinate constipation was present.

*Diagnosis.*—The diagnosis of the specific condition found at operation was not made previously. The symptoms and signs

of intestinal obstruction were present, but nothing definite could be felt in the abdomen. Subjectively pain was the most prominent symptom. Intense rigidity due to pain and the patient's efforts in breathing interfered greatly with the palpation of the abdomen.

Laboratory examinations revealed 21,800 leukocytes, 91 per cent. polymorphonuclear cells, the urine contained some albumin, no casts, with a specific gravity ranging from 1011 to 1022. A

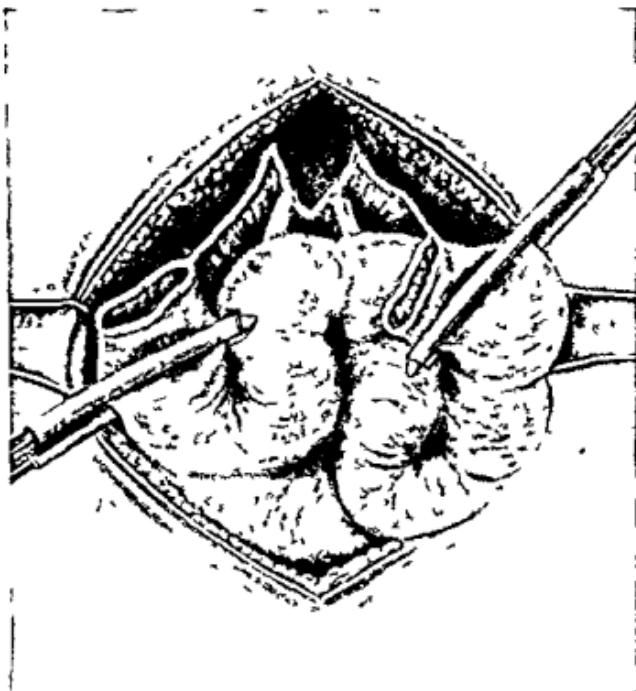


Fig. 53.—About 30 inches of ileum were excised.

smear from the peritoneal fluid showed pus-cells. Cultures developed a few growths of short chain streptococci.

At operation under local anesthesia was found thrombosis of the mesenteric artery with massive gangrene of the ileum (Fig. 52). About 30 inches of gut were removed, an end-to-end anastomosis was performed (Figs. 53, 54). The abdomen was closed without drainage; the patient made an uneventful recovery.

*Laboratory Record.*—The specimen consists of a portion of the ileum measuring 2 feet in length; the middle portion is dark green in color. The specimen measures 5 cm. in diameter and in places perforations are evident. The middle portion presents a fibrinopurulent exudate, the mesentery is markedly injected and thickened. There is a similar piece of ileum 7 cm. in length, dark red in color. The mesentery is also injected. Microscopically, the section of ileum examined shows a hemorrhagic ex-

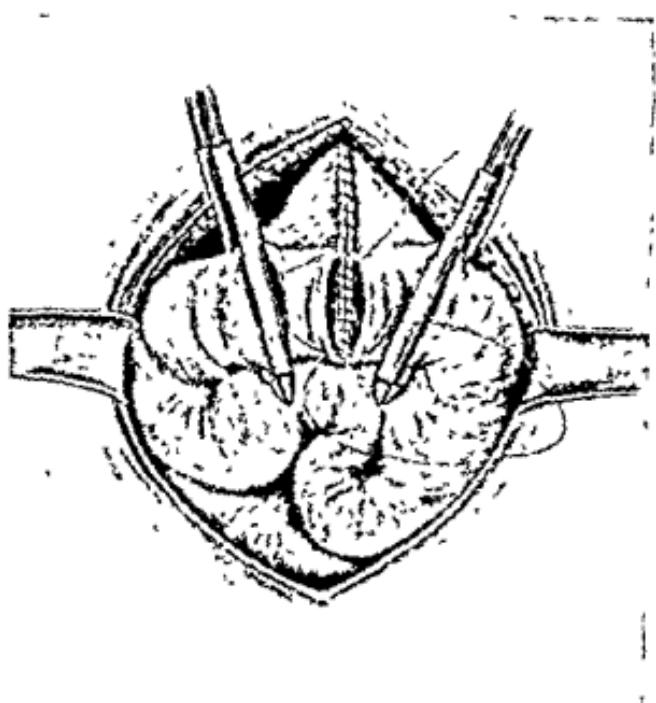


Fig. 54.—An end-to-end anastomosis completed the operation

travasation of all the coats, necrosis, and round-cell infiltration. Nothing of the original structure can be recognized. Diagnosis: Gangrene of the ileum.

**3. A Case of Diaphragmatic Hernia Followed, Again, in Four Weeks by Acute Intestinal Obstruction.**—D. H. Aged seven. Admitted to the Mt. Sinai Hospital June 18, 1923. The previous history is of some importance on account of an opera-

tion performed for an empyema complicating measles five months previously. Several cases of diaphragmatic hernia following this operation have been reported. He had never been a well child, having had a bilateral otitis media since birth. He was a bottle fed baby on account of postpuerperal insanity in the mother. Two weeks before the writer saw the patient in consultation he was suddenly seized with pain in the epigastric region. The child was constipated but cathartics moved his bowels. He vomited once. As the child improved no further attention was paid to him with the exception of the regular administration of the cathartic. He was in fair condition and was able to play with other children. A few days later the child was again seized with severe abdominal pain cramp like in character. He vomited profusely a whitish material, which varied at times to a brown and green color of the vomitus. He was constipated. Finally he was unable to take food at all. He still continued to vomit large quantities of fluid as described above.

We advised immediate operation but could not obtain the consent of the father. The child was transferred to the pediatric service. There he was not considered an operative case no absolute diagnosis could be made, though a diagnosis of acidosis was considered. The ears were examined by the otologist, but the cause for the symptoms could not be found there. The ophthalmologist reported spontaneous horizontal nystagmus to the right and left.

Physical examination revealed a very pale, much emaciated child, the abdomen was scaphoid, all the ribs were plainly seen, the muscles of the arms and legs lacked tone. The child lay limp and at short intervals a varying amount of colorless fluid would be vomited without effort, the corners of the mouth and cheeks were excoriated on account of the action of the vomitus on the skin.

The diagnosis was made by x ray (Fig. 55). Although a tentative diagnosis of diaphragmatic hernia had been made before the full report of the radiologist was received, he found a six hour retention of barium in that portion of the stomach

which lay within the chest wall. After the barium was taken it appeared to enter a pouch. This seemed to be the midportion of the stomach. At no time during the examination did the barium leave the stomach, indicating complete obstruction.



Fig. 55.—Shows the barium meal in the pouch above the diaphragm. Part of the great omentum was also drawn up through the hole in the dia-phragm. The transverse colon followed just to the opening

The urine examination showed a trace of albumin; no acetone or casts. There was always a leukocytosis ranging from 12,600 to 20,800. The polymorphonuclear cells ranged from 75 to 87 per cent. An occasional nucleated red cell was found. The ex-

amination of the vomitus gave a positive reaction for bile and blood. No free hydrochloric acid, but a total acidity of 95 per cent. was present.

*Operation.*—The first operation was performed on June 26, 1923, under local anesthesia, six days following admission to the hospital. Upon opening the abdomen we found the stomach,

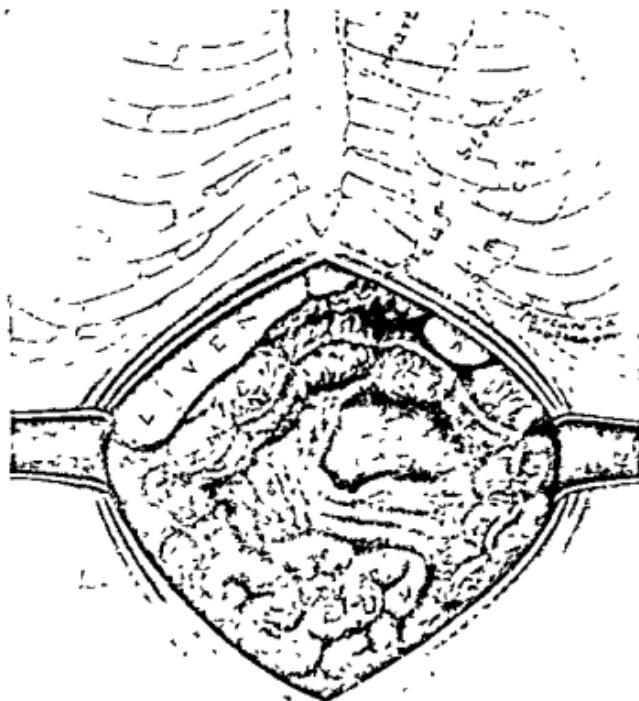


Fig. 56.—Drawn with the x-ray as a guide. Note the stomach with its constriction at the aperture in the diaphragm. The stomach and great omentum are shown in dotted lines. Note the proximity of the heart to the stomach. The heart was easily palpated at operation.

transverse colon, and great omentum drawn up through a circular rent in the diaphragm (Fig. 56). Traction on the great omentum brought the transverse colon and stomach, which were greatly dilated, back in their proper relations. After large pads were placed over the viscera traction downward revealed a large circular aperture (Fig. 57) about  $1\frac{1}{2}$  inches in diameter to the

After operation the patient's temperature rose to  $105\frac{1}{2}$ ° F., pulse 140, and respirations 40. She died several hours after operation. Her death was unexpected because she did not seem to be nearly so sick as the patients who immediately preceded her, and the operation was certainly less grave than those performed on the two cases above. The operation was, however, performed on one of the hottest nights of the year (June 20th).

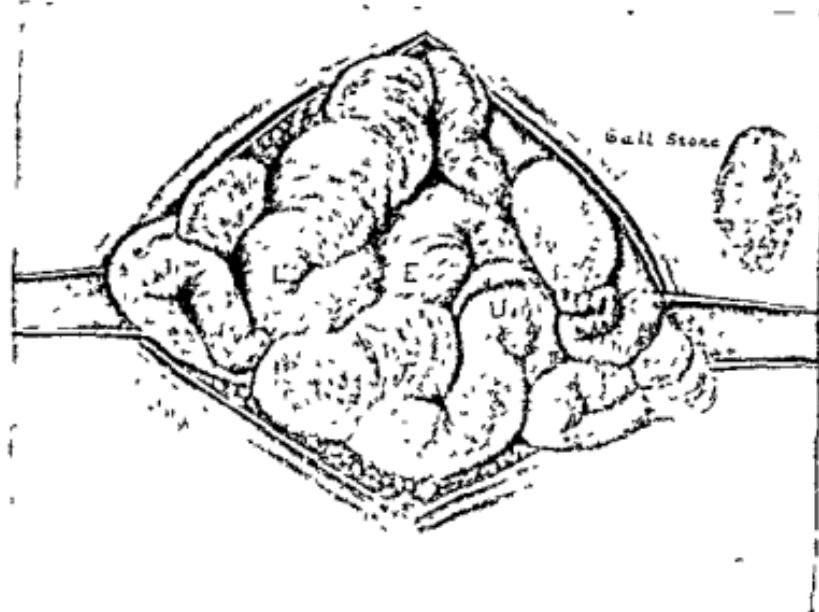


Fig 58.—Note the distention of the ileum proximal to the gall-stone. Actual size of the stone shown to the right

This factor was in a great measure responsible for this fatality, as we considered it a death due to heat-stroke.

**5. Congenital Absence of a Portion of the Ileum.**—Baby S. Three days old. Immediately after birth the baby vomited. The abdomen was distended. Rigidity followed and palpation induced crying. Some meconium was passed, but later constipation ensued. Three days after birth we operated on the patient and found a congenital absence of the ileum near the ileocecal valve (Fig. 59). The intestines were somewhat smaller than those found in the newborn. This happened to

be the third case of this type of deficiency observed in a comparatively short time. The baby was in very poor condition



Fig. 59.—Note the band running from the end of the ileum to the head of the cecum. Here is where the ileocecal valve should have been.

on the operating-table. No radical operation was even tried to remedy the deformity. The infant died a few hours after operation.



## CLINIC OF DR EDMUND B PIPER

UNIVERSITY HOSPITAL

### TREATMENT OF PUERPERAL SEPTICEMIA

PATIENT, Mrs K applied at Prenatal Clinic, where she received usual care, and was subsequently admitted to the hospital in labor. She has had one child before delivered normally. On the date of admission (December 4th) she was delivered at 5 P M labor having started at 9 A M, her membranes having ruptured several days before admission. This point especially should be borne in mind in the study of this case. Her delivery was entirely normal. She was examined but once before delivery. On the 5th and 6th of the month her temperature was practically normal never rising above 99° F. On the 7th of the month, which was the third day of her puerperium, her temperature rose to 102 $\frac{1}{2}$ ° F dropping the following day, but not quite reaching normal returning again to 103° F. On the 9th, the fifth day of her puerperium, her temperature reached 104 $\frac{2}{3}$ ° F and again today, December 10th 104 $\frac{2}{3}$ ° F. On the 8th she had a slight chill, which has not recurred since. At the time of this chill there was a very marked decrease in the lochia, which has continued to be scanty since that time.

In this case we are unquestionably dealing with some type of puerperal infection. In order that we may more clearly study this particular case and all the cases of a similar nature, let us classify them as follows:

First All cases in the puerperium which develop a sudden rise in temperature with the usual accompanying symptoms, where these symptoms are definitely dependent upon the child-bearing act, must be classified as *puerperal infection*.

Second Those cases in which the evidence of infection is in all probability due to the absorption of the toxins of putrefactive bacteria should be known as *puerperal septicemia*.

Third: Those cases in which the infection starting in the birth canal, extends elsewhere, either by the lymph channels, the blood-stream, or direct contiguity, may come under the head of *puerperal sepsis*.

Fourth: All cases of puerperal sepsis in which we are able to demonstrate by laboratory methods micro-organisms within the blood-stream we call *puerperal septicemia*.

It is, therefore, clear that all of these conditions come under the classification of puerperal infection. The clinical difference between sapremia and local infection in the birth canal lies in the fact that the former clears up almost immediately upon the institution of drainage, whereas the local infection may run on for a long period and still remain a local infection. All cases of puerperal septicemia under this classification are puerperal sepsis, but a localized infection of the birth canal is not sepsis, nor is every case of sepsis necessarily septicemia. Some might say that we should speak of septicemia as bacteremia, but, as Wassermann points out, the latter may be present temporarily, whereas the former, in reality, is a condition in which bacteria multiply within the blood-stream, usually increasing in virulence with great rapidity.

This case, as we first observe it, is either sapremia or a local endometritis, which would put it under the classification of puerperal infection. As there is a definite decrease in the lochia, we may be reasonably sure that in part the symptoms are due to the absorption of the toxins from dead material. Whether or not there may be added to this condition the factor of local infection, observation of the progress of the symptoms alone can tell. One thing we do know, however, there is an unquestioned predisposition to infection in those cases in which there has been a premature rupture of the membranes, which occurred in this case a matter of days before the onset of actual labor. There is probably no one single accidental factor in the causation of puerperal infection in the birth canal of graver importance than this. It certainly should be looked upon as a danger signal. Under these circumstances frequent examinations should be avoided whenever possible.

It is an interesting study to observe the progress of this type of case, but it is distinctly not a pleasant one, particularly if one happens to be the obstetrician in charge. Fortunately, in our studies here, with the arrangements whereby we can take care of these cases, we are able to see a large number of this type of case, sent in after delivery, without jeopardizing the convalescence of our own cases. Since this case has been delivered here, under the best of conditions, with but one examination, we must accept the entire responsibility.

No matter how much interest there may be in the study of these conditions, the most important factor is their treatment. The first thing to be thought of in this case is separation from the normal puerperal case. She was placed in the Septic Ward, and measures were instituted to recreate the flow of lochia. It seems the most difficult thing to impress upon the undergraduate student that the first thing to be thought of is the patient's position. This patient, when it was first noticed that there was a decrease in her lochia, was put in the Fowler position. Up to the present this has been unsuccessful. In a day or so, if the lochia remains scant, we shall give her an intra uterine douch, hoping in this way to re establish the drainage if the case is one of sapremia, and to have some deterrent effect upon the growth of bacteria if there is infection present. Various solutions have been recommended. In this clinic we have used at various times Lugol's solution, a mixture of iodin, alcohol, and water, weak mercurochrome, and at present a modified Dakin's solution. My own feeling is that the re establishment of drainage is of the greatest importance, and if properly used with a return flow irrigating nozzle, any good, reliable, non irritating antiseptic is of value.

The progress of this case must be watched with great care. Judgment as to when this condition has ceased to be a localized puerperal infection of the birth canal and has become a puerperal sepsis is difficult to determine. On the other hand, where puerperal septicemia does occur, a negative blood culture is no absolute evidence that we have not septicemia, but, as a rule,

we prefer to wait for a positive blood-culture before instituting treatment.

In very severe cases, which give every appearance of a blood-stream infection, of a very fulminating character, we do commence treatment without awaiting blood-culture, removing the blood for the culture at this time in order that we may know later whether or not we have been dealing with a septicemia.

With the definite hope that this particular case will clear up under position and intra-uterine douche, if the latter is necessary, we will go into the study of what we shall do in the event that these measures prove of no avail and we later find we have a positive blood-culture.

About four years ago I became particularly interested in blood-stream infection, owing to the fact that I was unfortunate in having a case of this nature that I had delivered in my private practice. The idea of the possibility of the intravenous injection of mercurochrome occurred to me, and with the aid of Dr. Herbert Fox, director of the William Pepper Laboratory, and Dr. Thomas McMillan, who did the largest part of the actual animal experimentation, we carried out a series of experiments upon which I have based the further clinical application. I will not go into the experimentation, which has been described elsewhere.<sup>1</sup>

We felt at that time, and we feel now more so, that there was definitely some curative action in this method of combating septicemia. At the time of the first report of this work, due to the fact that, at first, we only used it on cases that were *in extremis*, we were unable to determine whether or not the drug had any deleterious effect on the patient's kidneys. We have since found in a few rare cases that in the maximum dose in a moribund case there was definitely some impairment of the kidney function. Whether this was due to the drug or the existing nephritis could not absolutely be stated. To say that this

<sup>1</sup>"The Treatment of Puerperal Sepsis by the Use of Mercurochrome Intravenously, With a Report of Animal Experimentation in the Chemical I meeting of 1922

drug has no danger would be erroneous, but to quote the last paragraph of the conclusions in the original article, "All cases of puerperal septicemia are so serious and so frequently fatal that heroic measures are justified."

Owing to the apparent danger in some cases of injury to the kidneys we have changed our technic somewhat. In all cases we are using a comparatively small initial dose (from 20 to 30 c.c.), depending on the weight of the patient. From two to four days after the original dose we give a second dose if there has been no serious kidney complication. This dose is based on 30 c.c. for the first 100 pounds of body weight, increasing 5 c.c. for each additional 30 pounds of body weight up to a maximum dose of 45 c.c. Beyond 30 c.c. we increase our dose very guardedly, particularly if there has been a very marked decrease in the urinary output.

Let us consider this case. If a few days hence a blood-culture returns positive, our treatment shall be as follows: She is a woman weighing approximately 160 pounds. The minute we find a positive blood-culture (and I might say this will in all probability be the Streptococcus hemolyticus or the Streptococcus non-hemolyticus, with a possibility of the staphylococcus) the patient will receive 25 c.c. of a 1 per cent. solution of mercurochrome in sterile distilled water. This injection will be given with a salvarsan syringe and as slowly as possible. Her reaction should be about as follows: In from thirty minutes to six hours she will commence with a virulent diarrhea which will be stained red; she probably will pass urine which will give all the appearance of blood, and perhaps she may become nauseated and vomit, which will also be red in character. She will have a chill lasting anywhere from ten minutes to three-quarters of an hour, but with this comparatively small dose it is questionable whether it would extend beyond twenty minutes. Her temperature will rise possibly to 105° F., following which there will be a fall, probably to the normal, unless there has occurred a localization of the infection. When all of her symptoms of discomfort, caused by the injection, have disappeared, which would occur in two to three days, she will receive

a subsequent dose of about 35 c.c. of a 1 per cent. solution, always provided that her urinary output has kept up in these two days. The reaction which does occur from either of these doses must be treated symptomatically. We make it a routine that at the time of the first movement of the bowels an intestinal sedative is used. A small dose of powdered opium, some extract of belladonna, and bismuth. The other reactive symptoms are treated as one would treat any other similar condition. Local heat for the chill, cardiac stimulants when deemed necessary.

When the reaction following this drug has passed off and there is some sign of improvement in the general condition of the patient, we feel at least encouraged, and we then begin to look for and hope for a localization. When this takes place, we naturally hope that it will occur in a location that may be easily reached. In other words, a localization in Douglas' pouch may be drained by a vaginal puncture. Abscesses occurring over the surface of the body may be easily opened and drained in the usual surgical manner. The blood-culture is watched with great care, and in our experience, where patients last long enough to get subsequent blood-cultures, we find that we have been able to get a negative report. Of course, it makes no difference how frequently we have negative reports, unless the patient gets well the treatment is a failure. At times in this type of case there is occasionally seen such an overpowering fulminating type of infection that death occurs as rapidly as twenty-four hours after the onset.

As to the cause of the reaction which occurs no one may definitely say, but for the working hypothesis which has been arrived at in the animal work, and clinical observation since, we are inclined to believe that at least in part it is due to the drug's destruction of the bacteria within the vessel walls and the sudden change from living micro-organisms to dead ones. At least we are in hopes that that is the case, and one of the causes which clinically has made this hypothesis more impressive is that in these very ill cases in which we did not wait for a positive blood-culture, but took the blood-culture at the time of the in-

jection, we found that very frequently the reactive chill and all that went with it was absent where this blood-culture was negative.

In presenting this method of treatment it has not been our intention to give the impression that we have felt that herein we have found a cure-all for blood-stream infections, but we do feel that some of the results that we have seen, and have had reported to us, justify the attitude that there may be some merit in this method, and that thereby a few lives may be saved that otherwise would have been lost.



CLINIC OF DR EDWARD A SCHUMANN

FRANKFORD HOSPITAL

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A SERIES OF CASES PRESENTING ABDOMINAL TUMORS  
OF UNUSUAL TYPE WHICH GIVE RISE TO DIFFICUL-  
TIES IN DIAGNOSIS

Desmoid Tumor of Abdominal Wall

Bilateral Sarcoma of Ovary

Premature Separation of Placenta

THE first case is that of a woman thirty six years of age a multipara who has noted a gradual distention of the abdomen during the past two years Her past medical history has no bearing upon the condition there is no change in the menstrual cycle nor are there evidences of pregnancy Temperature, blood picture, and urine are normal

On inspection of the abdomen a large tumor is noted occupying the left lower quadrant and crossing the midline to the right The mass is regular in outline, not nodular, and rises and falls with the abdominal wall upon deep respiration On palpation the tumor is very hard and dense, and gives the impression of being attached to the abdominal parietes

The growth gives rise to no symptoms except a sense of weight and dragging in the abdomen

Vaginal examination discloses a normal parous birth canal, the uterus small, retroverted to third degree, not fixed, the tubes and ovaries negative

Bimanually a large tumor the size of an adult head can be felt anterior to the uterus and apparently springing from the abdominal wall

Tumors originating in the abdominal parietes are at best uncommon, and in women are usually one of two varieties cyst adenomata developing in the incision subsequent to the

removal of a pseudomyxomatous ovarian cyst and the so-called desmoid. Because of its great hardness and also because there is no history of a preceding ovarian cyst, a diagnosis of desmoid tumor is made and operation for its removal is performed.

On incising the skin and superficial fat the fascia of the recti muscles is seen tightly stretched over the large, hard tumor mass. The fascia is adherent to the growth, and on its being stripped away there is revealed a grayish-pink tumor of almost stony



Fig. 60.—Desmoid tumor of abdominal wall. Note the glistening connective-tissue structure.

hardness having a free blood-supply and easily enucleated from its bed.

The tumor being removed, the atrophied and thinned-out remainder of the rectus muscle resumes its normal place in the abdominal wall and the incision is closed, the tumor bed being obliterated by deep and superficial interrupted catgut sutures. The peritoneum has not been opened, the tumor stripping easily from the external surface of this membrane. Recovery of the patient was uneventful.

The specimen is a very hard, dense, ovoid tumor, grayish in color and possessing a distinct connective-tissue capsule. It measures 20 x 15 x 12 cm. On section, the entire body of the growth is composed of dense fibrous tissue, the bundles of cells arranged in an orderly manner, parallel to the long axis of the rectus muscle. Though the blood supply is poor, there is no evidence of necrosis.

The name "desmoid" was given to these growths by Muller in 1838 by reason of the oval bundle like shape and the bundle-like arrangement of the muscular and fibrous elements under the microscope.

Pfiefer in 1904 collected over 400 cases.

These tumors occur most frequently in women in the ratio of 7 to 1. Average age is thirty four, association with repeated pregnancies well known. Tumors are always in anterior or lateral abdominal wall, and although they may occur in any part of it, in 43 per cent of the cases they are associated with the rectus muscle or its sheath, particularly the posterior part.

The tumors are usually small, but may reach the size of the adult head or even greater.

The surface is smooth save when the tumor reaches immense size, when it may be lobulated.

Microscopically the growths are dense fibromata (Fig. 60).

The second case is that of a woman forty six years of age, who was admitted to the hospital in a condition of extreme debility, complaining of continuous, moderate vaginal bleeding for the past three months, with a rapid enlargement of the abdomen and progressive loss of strength.

The past history was that the patient had been in good health up to the onset of the present illness. Menses 14-28-4, never pregnant, though she had been married for twenty five years.

The present illness was ushered in by continuous vaginal bleeding, which was rapidly followed by notable enlargement of the lower abdomen. At no time had there been any pain.

On admission the temperature was 97.4° F., pulse 120. Red blood cells 1,820,000, white blood cells 9200, hemoglobin 50 per

cent. Urine negative. The mucous membranes were pale, the chest negative. The abdomen presented a somewhat irregular, hard tumor extending to within an inch of the umbilicus. The growth was not adherent to the abdominal wall, was uniformly dull on percussion, and was somewhat tender on deep palpation.

On bimanual examination the birth canal was found to be multiparous, the cervix small and soft, the uterus, tubes, and ovaries indistinguishable, and merged into one very large, fixed pelvic mass.

Taking into consideration the size and form of the tumor, the persistent vaginal bleeding, the rapid growth of the mass, the sterility of the patient, and the freedom from pain, a provisional diagnosis was made of a pelvic tumor undergoing malignant degeneration probably sarcomatous in type.

The combination of fibroid tumor with an exacerbation of an old pelvic inflammatory disease was considered and rejected because of the absence of pain and fever in the history, and because of the comparatively low leukocyte count.

The treatment of this case has elicited considerable discussion among the members of the gynecologic staff, and inasmuch as efforts to improve the anemia and preserve the strength of the patient by means of rest, abundant food, and the exhibition of iron and arsenic subcutaneously had definitely failed, it was determined to resort to operative measures, with subsequent blood transfusion, the source of the blood loss having been removed.

Under ether anesthesia the abdomen was opened and there was revealed a double tumor, the two portions meeting at about the midline. The growths were grayish-purple in color, fairly smooth, and each of a uniform contour about as large as an infant's head. On attempting to eventrate the growth there was immediate violent hemorrhage from many vessels springing from the tumor bed. As slight traction was made on the right tumor it came away in the hand with furious hemorrhage from the friable pedicle. A large clamp was applied to the entire pedicle and controlled the bleeding. The left tumor was now drawn up, its pedicle clamped, and the growth removed.

The uterus was seen to be about twice the normal size, soft and edematous, but apparently not involved in the neoplastic process. The floor of the pelvis and the broad ligaments were studded with masses of secondary malignant tissue, grayish in color and bleeding upon touch.



Fig. 61.—Bilateral ovarian sarcoma. The two ovaries are of almost the same size and the areas of hemorrhage and of penetration of the capsules by malignant cells are well shown.

The patient being in desperate condition, the pelvic cavity was firmly packed with gauze, the clamps left *in situ*, the incision closed above and below the pack and clamps, and the patient returned to bed, where she died within twelve hours of shock and hemorrhage in spite of stimulation, blood transfusion, etc.

The specimens removed were obviously both ovaries, the seat of malignant tumor growths. They measured roughly 12 x 8 x 8 cm in size, were purplish-gray in color, of soft pliable consistency, the membrana propria of each having been penetrated in many places by the tumor-cells. The blood-supply was exceedingly rich, many large veins coursing over the surface of the tumors and areas of hemorrhage being found in their interiors. On section, the growths presented a typical brain-like structure, areas of colloid material being surrounded by dense masses of tissue cells (Fig. 61).

On microscopic section the growths were found to be round-cell sarcomata of the perivascular type, the tissues showing considerable degeneration and some edema.

Ovarian sarcomata are interesting tumors, forming as they do about 2 per cent. of ovarian growths

They are common in children and have been found in a seven-month fetus

They occur at an average age of thirty-two years, somewhat earlier than this in Frank's experience. The patient under discussion having been forty-six years of age was considerably above the average age limit

These tumors are usually associated with ascites, which was not noted in our case

The types of sarcoma may usually be determined by the gross appearance, the more mature spindle cell, chondro- or osteosarcomata being firm, smooth, and pale in color, closely approximating fibromata in appearance, while the more embryonal form, the round cell and myxosarcomata, are softer, brain-like, and frequently present necrotic or hemorrhagic areas.

The prognosis in ovarian sarcoma is generally good if metastasis has not begun. In the case here reported there were such massive metastases in contiguous structures that even in the event of operative recovery death must have resulted within a short time

The third case is that of a woman thirty-three years of age, an IX para, who was admitted to the hospital suffering from

vaginal bleeding and a notable enlargement of the abdomen. Her medical history was irrelevant she having had 9 spontaneous labors, with 7 children living, and no miscarriages.

Her present illness had been preceded by three months of amenorrhea, without subjective symptoms of pregnancy, followed by one month of almost continuous vaginal bleeding unaccompanied by pains, but associated with the rapid development of an abdominal tumor.

Blood showed a moderate anemia without leukocytosis. Wassermann reaction was negative and the urine was negative.

Upon examination the patient was noted to be of good physique, somewhat pale. The vaginal outlet was multiparous, the perineum relaxed, the cervix soft, with a wide bilateral laceration. There was a suspicion of cyanosis of the vaginal mucosa, no Hegar's sign, no ballottement. The uterus was regularly enlarged to the umbilicus about the size of a six month pregnancy. Its tone was firm, the consistency that of a thick walled cyst.

No fetal movements could be detected, nor could heart sounds be heard. The breasts were relaxed and presented milk (the youngest child was not yet a year old) and there was slight pigmentation of the median abdominal line.

X Ray examination was negative as to the presence of a fetal body.

The diagnostic features in this case were:

The amenorrhea in a woman of child bearing age.

The rapid, regular, enlargement of the uterus too large for pregnancy of such duration as would correspond with the period of amenorrhea.

The profuse vaginal bleeding.

Upon these facts a provisional diagnosis was made of hydatidiform mole, and treatment advised was abdominal hysterotomy, it being the opinion of the clinic that this procedure is the most conservative and safe method of treatment in the presence of hydatid mole.

Laparotomy was performed under ether anesthesia, and the uterus found smoothly and regularly enlarged, the fundus at

the umbilicus, its tone firm and tense. The tubes and ovaries were normal. On incising this organ a quantity of old blood-clot and degenerated blood escaped, the bleeding having taken place between the uterine wall and the fetal membranes which now presented at the incision. The sac was opened and a 12-cm. fetus extracted with the placenta. The uterine cavity was sponged clean, the incision in its wall closed by suture, and the



Fig. 62.—Massive infarction of placenta with a fetus acrania. The infarction is seen on the right side of the placenta.

incision in the abdominal parieta sutured. The patient made an uninterrupted recovery.

The specimen obtained was a most interesting one.

The fetus, 12 cm. in length and living at the time of delivery, was a monster of the acrania type, the entire posterior portion of the skull being absent, and a huge hernia cerebri covering the calvarium. The eyes were in marked exophthalmos, the nose flattened, the fetus presenting the typical frog-face aspect so

characteristic of this form of teratoma. The cord was normal, but the placenta was most unusual. In nearly one half of the organ the normal placental tissue was replaced by a firm white infarct, fibrous in character, and so smooth in its maternal aspect that it was evidently only in contact with the uterine wall, without actual union having taken place (Fig. 62).

Of the remainder of the placenta only two cotyledons presented typical chorionic villi, and from these two the fetus had evidently derived sufficient blood supply to maintain life. The other cotyledons had been separated from their uterine attachment for some time, old clotted blood covering them and being rather firmly adherent.

The corrected diagnosis was then premature separation of a placenta the seat of massive white infarction, fetus acrania, and intra uterine hemorrhage.

*Group 2*—Four cases of labor in patients who have previously undergone cesarean section.

The management of labor in women who have had cesarean section for the termination of a previous pregnancy offers many problems some of which are illustrated among the group here presented.

1 A young woman of twenty six was delivered of her first child by cesarean section four years ago, the indications being persistent uterine inertia with a large, postmature child. The operation was performed under the best auspices by a competent obstetric surgeon and mother and child made an uneventful recovery. The patient and her husband were anxious that she be spared a second abdominal hysterotomy if possible. The progress of pregnancy was normal, the pelvic measurements indicated a well developed bony pelvis and the child was not unduly large, being 50 cm in length by Ahlfeld's rule of estimating fetal size at maturity. Labor came on within twenty four hours of calculated term, the pains recurring at regular intervals and with increasing severity. The fetus was in L O A the head well engaged. After two hours of labor the situation was as follows. The cervix was dilated to admit three fingers, the membranes pouching, the head was firmly engaged, the uterine

contractions regular and strong, the fetus in good condition, as was the mother.

It appeared that complete dilatation with a low forceps delivery would prove a practicable technic for delivery. However, on carefully palpating the abdomen, a deep cleft was discovered in the anterior fundal wall of the uterus, the cleft becoming so definite during a contraction that two fingers could be inserted into it.

A diagnosis of impending rupture of the uterine scar was made, and the patient subjected to immediate abdominal section under nitrous-oxid-oxygen anesthesia. Upon exposing the uterus through the previous scar in the abdominal wall the upper third of the old uterine incision was found spread apart, a few muscle bundles and connective tissue plus the visceral peritoneum covering the gap. So thin was this covering that the breech of the fetus could be plainly seen lying under the gaping incision.

The uterus was again incised, the child extracted, the uterine wall closed by tier suture, and the tubes excised at their cornual insertion. Convalescence was uneventful, the child well.

The second case is that of a negro woman aged thirty-two, whose obstetric history states that she had one spontaneous delivery, then a cesarean section for central placenta praevia two years ago. She now applies for treatment, being pregnant at term and in the first stage of labor, pains having been active for three hours on admission to the house.

On examination the pelvis was found to be of normal size, the fetus in L. O. A., the head engaged, the cervix effaced and dilated to admit three fingers, the membranes pouching. The abdominal and uterine scars appeared firm. With the preceding case in mind, all preparations were made for the immediate performance of abdominal section, if necessary, and the labor was allowed to proceed. Within an hour the membranes had ruptured spontaneously, the cervix dilated, and a healthy child weighing 7 pounds, 8 ounces was spontaneously and easily born. There was no abnormality of the third stage and mother and child are well.

The third case is that of a woman thirty-one years of age, who was first seen five years ago, after she had been delivered of a dead and mutilated baby, the result of a difficult forceps extraction in a contracted pelvis

The pelvic measurements were spine 24 cm, crest 25 cm, external conjugate 17 cm, diagonal conjugate 10+ cm, and the true conjugate estimated at 8 cm

The patient applied for delivery in June, 1918, and the fetus being found of full size, elective cesarean section was proposed, accepted, and performed, with the delivery of a living infant 8 pounds, 6 ounces in weight. In September, 1920 this woman was again delivered by cesarean section. In October, 1922 a third was performed, and she is now convalescing from her fourth hysterotomy. In none of the secondary operations were the scars of the first incisions distinguishable, nor was there any evidence whatever of uterine pathology. The method of closure used was that which is standard in the clinic, namely interrupted suture of No 2 chromic catgut from serosa to mucosa with a double tier of No 2 gut, uniting the muscle in continuous suture the serosa being approximated over the knots of the interrupted sutures by a running stitch of No 0 chromic gut.

All of the sections were of the high type, the uterine incision in the midline of the fundus. Eversion of the uterus was not practised nor was the cavity packed.

At the last section the uterine ends of the fallopian tubes were excised from the cornua and the cornual wounds closed, this being done at the request of the patient and her husband.

The fourth case is that of a colored woman thirty four years of age, who gave a history of having undergone cesarean section in a distant city, four years before, mother and child making a good recovery. The indication for the operation was not known, the pelvis being of normal size.

She was admitted to the hospital eight months pregnant and complaining of generalized abdominal pain and great weakness.

Examination revealed a well formed young woman, heart

and lungs negative, the abdomen distended to about the usual size of a full-term pregnancy. There were no fetal movements present, nor were heart sounds audible. The fetal extremities could be palpated with considerable ease, although the head was not distinguished at the pelvic brim. On vaginal examination no presenting part could be felt, the cervix was small and soft, there was no bleeding, and, bimanually, the infant could be determined to lie in an oblique position.

There was moderate anemia, no leukocytosis, and the urine was normal. A later report stated that Wassermann reaction was negative.

On analyzing the important features of this case one was struck by the fact that although the patient did not appear to be extremely ill, the history of sudden uterine pain, which shortly afterward was followed by a dull, generalized abdominal ache, together with the indeterminate position of the fetus, the absence of all evidence of fetal life, and history of a previous cesarean section pointed to occurrence of some intra-abdominal accident, and immediate laparotomy was decided upon.

Under ether anesthesia the abdomen was incised, and the fetus disclosed, lying free in the peritoneal cavity, the head deep in the left kidney fossa. The membranes were ruptured, liquor amni and some blood, though comparatively little, being present.

The uterine scar had completely separated, leaving a gaping wound about 3 inches in length in the anterior wall of the organ, and the detached placenta had been partially expelled from this opening, when uterine contraction had caught the placenta between the edges of the wound and held it with sufficient pressure to prevent free bleeding. The dead infant was delivered from the abdominal cavity, the uterus removed by supravaginal hysterectomy, and the abdomen closed, the patient making an uneventful recovery.

The salient points in this case are the complete separation of the uterine wound, and the expulsion of the child into the peritoneal cavity without excessive pain or without evidence

of shock on the part of the patient the latter being explained by the paucity of hemorrhage

The foregoing cases are most instructive with regard to the accidents which may be expected to complicate labor subsequent to cesarean section

In the last case spontaneous rupture of the uterine scar had taken place before the onset of labor

In the first case rupture of the scar was imminent, and was forestalled but a short time by the performance of a second section

In the second case the previous section had no bearing upon labor, which was easy and spontaneous

In the third case, when three sections were done for an absolute indication of marked pelvic deformity, there was no evidence of disability of the uterine scar whatsoever, and, except for the pelvic contraction, labor should have terminated without complication attributable to the sections

The old dictum that once a cesarean always a cesarean is not to be regarded as being true, but patients awaiting labor, who have been subjected to this operation, should be considered as distinct obstetric risks and the following general rules are laid down for their management

1 Women who have had section should never be allowed to go into labor in their homes, but should be admitted to hospital a few days before estimated term

2 When the previous section was performed upon the indications of disproportion between fetus and maternal pelvis, or when such disproportion exists at the end of pregnancy, repeated section should be resorted to after a brief test of labor, prolonged forceps operations, versions, or any procedure which may put undue strain upon the presumably weakened uterine wall being contraindicated

3 The onset of unusual abdominal symptoms, lancinating pain, sudden alteration of the position of presentation of the fetus, marked changes in maternal pulse character, etc., should be considered as indications of some intra abdominal accident and should occasion immediate section

4. When a previously cesareanized woman falls into labor all facilities should be at hand for immediate section, operating-room force assembled, instruments sterilized, etc., since, should rupture of the uterus occur, the operative mortality and morbidity rises in almost direct ratio to the time elapsing between the accident and the operation.

CLINIC OF DRs E L ELIASON  
AND D HINTON

UNIVERSITY HOSPITAL

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COMPLICATED FRACTURES OF THE SURGICAL NECK  
OF THE HUMERUS<sup>1</sup>

Case I.—The first case in this small series I wish to report upon is one of low fracture of the surgical neck of the humerus in which reduction could not be accomplished. The patient, a woman forty years of age, tripped on a stairs platform, falling headlong, with outstretched arm, down six steps, turning heels overhead, which gymnastic feat I think accounts for the peculiar situation with regard to the fracture. The x ray shows a short spiral fracture. With the patient under a general anesthetic and using the fluoroscope an attempt was made at reduction.

It was noted that crepitus could not be obtained, although the position looked satisfactory. A lateral view, however, showed displacement (Fig. 63, A) which could not be overcome, there always remaining a space between the fragments. The absence of crepitus and this persistent space meant but one thing namely, interposition of soft parts. It was thought wise to try abduction and traction on a Thomas splint. This was tried for forty eight hours, with no improvement. Now we know if reposition is not well advanced by traction in two days something is wrong and this something was inability to approximate the ends after the shortening was overcome, due supposedly to interposition of soft parts. We now have one indication for open reduction, namely, inability to obtain a sufficiently satisfactory reduction to insure good function. We do not have this, and we can conscientiously advise open reduction knowing that we will not get union otherwise.

<sup>1</sup>This article has been curtailed on account of lack of space

*Operation.*—Under gas anesthesia we prepare the arm, painting it with an alcoholic solution of 5 per cent. picric acid and covering the lower part of the arm, the forearm, and hand with sterile tricot hose. This not only protects against contamination, but makes an excellent underdressing for a plaster-of-Paris casing. Our great danger in this work is infection, and at all times the utmost precautions must be taken. I now plan my incision to fall in line with the greater tuberosity, making it about 4 inches long, with its center opposite the lower end of



Fig. 63.—A, Showing deformity on entering the hospital B, After internal fixation

the upper fragment. This is important, for if you place your incision with reference to the upper end of the lower fragment, it may fall in an awkward position after reduction and need to be lengthened. The skin knife is now discarded and towels are sewed around the wound, completely excluding skin from sight. At no time during the operation should hands enter the wound unless shod with a fresh glove, and no sponges should be used a second time. I now split the anterior fibers of the deltoid muscle and expose the fracture site after wiping out the clots. We now see the reason closed reduction failed. The

fracture line passed through the pectoral fold insertion and the lower fragment when it returned from the hyperabduction of the patient's somersault pierced the fibers of the latissimus dorsi muscle where you now see it. By abduction and leverage we release the fragment from its unusual posterior position and you now see the two fragments coapt. This perfect approximation is only maintained if the arm is held abducted and with the flexed forearm looking forward. When we attempt to adduct the arm and internally rotate the fragments separate. A four hole Sherman plate with  $\frac{3}{8}$  inch self tapping screws unites the two ends. The two screws above encounter spongy bone so I therefore encircle the bone and plate with a wire as an extra precaution (Fig 63 B). I again test to see if I can place the arm beside the body with the forearm across the chest. You can plainly see this opens the fracture line and would result in early dislocation of the screws. With the arm abducted 45 degrees, the forearm at right angles and presenting forward the strain is relieved and the fracture line closes. This position of equilibrium is extremely important for muscle strain will loosen internal fixation and result in a dislocated plate and bone displacement. We now look to our hemostasis and finding a dry wound we proceed to close. A small rubber tube with a silk thread pilot through the exposed end is placed in the lower wound angle and the wound closed with catgut throughout. The silk pilot thread is brought out through a split in the gauze dressing and curled up under a pill box top used as a marker. One assistant is now delegated to hold the limb in the abducted position. This assistant is responsible for this and for nothing else. Lack of attention in maintaining a fixed position has frequently resulted in a fracture of the plate. The limb is now placed on a splint devised by us consisting of a triangle augmented by an internal right angled splint (Fig 64) which is bound to the body by a plaster of Paris dressing. The pill box shows by its prominence the position of the silk pilot. After forty eight hours the box is exposed the silk is grasped and the drain removed without disturbing the dressing. The catgut stitches in the skin absorb and no large fenestra need be cut in

the dressing, through which defect a fracture site might angle. I do not expect to remove the internal fixation, for, if the wound remains clean and the plate remains as originally placed, it never causes disturbance.

*Comment.*—The patient had a normal convalescence; the dressing was removed in six weeks and the anatomic and functional results were perfect after four months. During con-



Fig. 64.—Method of fixation and dressing in the abducted position (This is not the patient spoken of in this article, but he does have a plated humerus.)

valescence the patient was treated with baking, massage, and active motion for the muscles and joints. We no longer advocate forcing passive motion.

**Case II.**—The next case I present shows a not uncommon line of the fracture which causes difficulty or inability to obtain a good anatomic reposition. This man, aged fifty-six, fell down

stairs and sustained a fracture of the surgical neck of the left humerus. As is our practice in fracture cases, an attempt was made to reduce the fracture with the aid of the fluoroscope and a general anesthetic. The fracture surfaces would not engage. A long spur of bone attached to the upper fragment merely by periosteum seemed to be displaced so that it lay across the broken surface of the upper fragment, and served as a skid upon which the lower fragment slipped out of position. After some manipulation this was turned out into position, but then

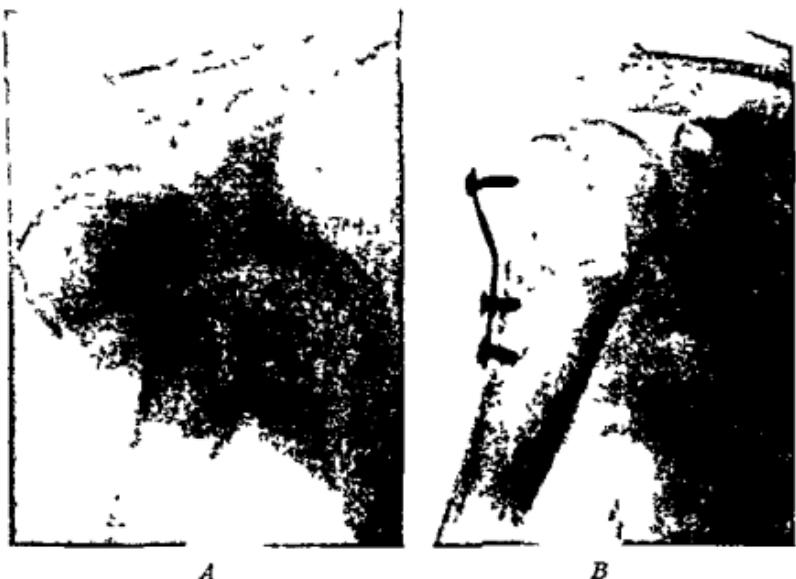


Fig. 65.—A shows the deformity and the complicating spur B, On abduction triangle with plaster-of-Paris dressing.

it completely interfered with reposition (Fig. 65, *A*); hence, open reduction was indicated. This was performed according to the technic described in the first case, and perfect reposition was obtained after lifting out the loose spur and removing it. Only one screw could be placed in the upper fragment, due to the crushed condition opposite the other screw hole. The screw did not snug down when driven home and, consequently, was removed. A loose screw does no good and may do harm. Before closing the wound the arm was placed in the position it

would assume on a Mitteldorf triangle, and as no strain was noted on the union, the wound was closed as above and the limb dressed on the triangle with plaster of Paris (Fig. 65, B).

*Follow-up Report.*—Ten weeks after the operation the follow-up report states that the "alignment is perfect, the plate in position, and union solid. There is some impairment of abduction and external rotation, but other motions are good."

*Comment.*—In our practice open reduction is indicated when a fracture cannot be reduced or reduction cannot be maintained well enough to promise good function and a satisfactory lack of deformity. We do not demand absolute coaptation. The pilot drain is always used for forty-eight hours to prevent a hematoma. Since using this we have had but one infection, which was reported in these clinics one year ago.

The wounds are all closed with iodin gut, and only a small fenestra,  $1\frac{1}{2}$  x 1 inch, is cut to allow removal of the drain by pulling up the pilot thread and pulling out the drain without disturbing the dressing.

**Case III.**—This patient is a very stout Jewish woman sixty-two years of age, who fell down stairs, injuring her left shoulder. An x-ray (Fig. 66, A) revealed a subcoracoid dislocation of the head of the humerus, and a spiral Y fracture of the surgical neck extending to and separating the head from the greater tuberosity and from the shaft. I saw the case within four hours of the injury, and advised an attempted reduction with the aid of the fluoroscope, if necessary, under gas anesthesia. Gas, rather than our preference, ether, was chosen because her family doctor stated that she had a bad nephritis with blood urea 60 mgm per 100 c.c. of blood. With the patient under the anesthetic the arm was abducted to beyond a right angle to the trunk, carrying it up into the extreme position in which we assume it was at the time the injury occurred. I next placed my unshod right foot between her shoulder and neck and made steady traction. My assistant stood across the table and made a prying pressure with his closed fist between the chest and the dislocated head, without success. Thinking that this extreme

abduction was probably tightening the edges of the slit in the capsule, thus preventing the return of the head, I carried the direction of the pull down to shoulder level, and, aided with the fist pressure, accomplished a reduction of the dislocation. The limb was then carried to the side and a glimpse taken through its fluoroscope, which revealed the position as shown in Fig. 66, B. Further manipulation did not improve matters, due, I think, to the greater tuberosity being wedged in between the head and the upper outer edge of the broken shaft.

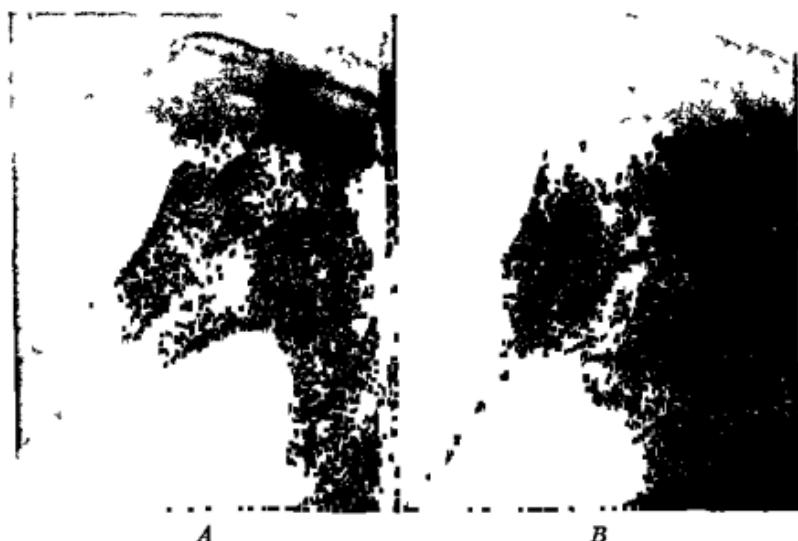


Fig. 66.—A, Fracture dislocation of the upper end of the humerus. B, Dislocation and fracture reduced.

Under the circumstances it was deemed wise to be content. The arm was bound to the side with a long pad in the axilla, and the forearm was slung at the wrist which, in turn, was bound to the side.

*Comment*.—It is extremely important in all these cases of fractures of the shaft of the humerus that the forearm be fixed to the body, for, with the elbow flexed, any motion toward abduction must necessarily cause external rotation at the fracture site. Such movement occurring many times daily, as would happen, due to the patient's activities in changing clothing,

turning in bed, leaning over to fasten shoes, etc., naturally favors delayed union or non-union, especially when the fracture is farther down the shaft.

*Follow-up Report.*—The patient had a good anatomic and functional result, full motion and freedom from pain, when heard from four months after the accident.

**Case IV.**—This is a case of comminuted fracture of the neck of the humerus with a subcoracoid dislocation of the head. The



Fig. 67.—Dislocation with a comminuted impacted fracture.

patient, a woman sixty-five years of age, sustained this injury. She was taken to another hospital where an x-ray revealed a dislocation of the head and an impacted comminution of the surgical neck. Her physician attempted reduction, with the result shown in Fig. 67, namely, a breaking up of the previous impaction and a return of the shaft to the relatively normal position. The avulsed part of the greater tuberosity can also be seen just under the acromial tip.

With the patient under an anesthetic and with the use of the fluoroscope we made attempt by abduction and traction on the

arm and fist pressure on the dislocated head. Nothing was accomplished. The patient's family was consulted with regard to operation, and when they were told that the patient had a poor heart and diseased kidneys, shown by her shortness of breath and swollen limbs, they very properly refused operative intervention, consequently, the case was discharged from the hospital.

*Comment*—There are several procedures which may be attempted in such cases as the above. If the case is only a few hours old an attempt similar to the above may be made with success. If this fails operative methods must be tried, exposing the upper fragment, a hole is drilled in the dislocated fragment, and with the use of a McBurney Porter or other style hook the head is reduced. If this fragment is still attached to some of its ligaments and other soft parts, the fracture site is treated with internal fixation, if required and the limb treated as a fracture. But if the dislocated fragment has been severely avulsed from its blood supply, it must be excised. The other alternative is to follow the plan forced upon us in this case, impressing upon the patient, however, that she will have a crippled and painful shoulder. This case may well serve as an illustration. We all see many fractures, especially in this region in stout women, such as this one with myocarditis and nephritis. Here failure to obtain reduction is not necessarily an indication for operation. In other words, before advising open reduction we must be conscientiously able to offer that patient not only a recovery from the operation but a better functional result. We can offer neither in this instance, therefore we are satisfied with the family decision and can only hope for a fair result.

*Follow-up Report*—Patient has 60 per cent function and gradually decreasing pain in the ulnar nerve distribution after six months.

**Case V**—This little girl of eleven years had a separation of the upper humeral epiphysis. She came to the hospital complaining of pain, with loss of ability to use the left arm. She gave

the history that while running she tripped over a wire, falling upon her left side with the left arm extended. She experienced exquisite pain and was no longer able to use her shoulder.

*Condition on Admission.*—Examination by the intern in the Receiving Ward revealed nothing abnormal about the child except the appearance of the left shoulder. "The rounded portion of the shoulder is moderately swollen. Just in the region of the deltoid muscle insertion there is an inward bowing suggestive of the change in the long axis of the humerus occurring in subcoracoid dislocations. Just below the outer third of the clavicle is a rounded prominence. The patient holds the extremity with flexed forearm, elbow slightly abducted and internally rotated. No crepitus can be elicited. The limb is about 1 inch shorter than its fellow. Either a subcoracoid dislocation of the humerus or an epiphyseal separation is suspected."

The surgeon in charge attempted to correct the deformity with the patient under gas anesthesia. The faulty axis of the humerus was corrected, at the same time causing the fulness under the clavicle to disappear. There was no distinct slip or snap as occurs in dislocation reduction, and the 1-inch shortening persisted. These findings plus the youth of the patient led the physician to suspect an epiphyseal separation rather than a dislocation, which latter is extremely rare in children. An x-ray was taken, and it was found that the usual deformity of lower fragment displaced inward and upward had been overcome and the lower fragment was thrown completely to the outer side (Fig. 68, A). This film showed also that the upper fragment, as is usual, was abducted and externally rotated, so that the articular surface presented downward. The patient was then transferred to our service in the hospital.

*Treatment.*—That same afternoon the patient was given ether anesthesia on the fluoroscopic table. Reduction was attempted after the Astley Cooper method of reducing a subcoracoid dislocation, but without results. Attempt was then made with abduction at a right angle to the trunk without success. The extremity was next carried into complete abduction up beside the head and a foot placed in the hollow of the

neck. Strong traction in this direction resulted in engaging the very edge of the two fragments as shown by the fluoroscope. Being careful not to dislodge the partial reduction, the arm was slowly carried toward the patient's side. With the arm within about 30 degrees of the side, a foot was again placed in the axilla and traction and manipulation used until the fragments slipped into perfect position (Fig. 68, *B*) and showed no tendency to become displaced. The arm was dressed bound to the patient's side, the forearm being slung at the wrist.

*Comment.*—Dislocation of the shoulder is extremely rare in early youth. Upper humeral epiphyseal separation is not uncommon and should have been the condition suspected from



Fig. 68.—*A*, After first reduction attempt *B*, After reduction

the first. The deformity shown in Fig. 68, *A* is the unusual one for this condition and, of course, resulted from a faulty idea of the real condition existing. The interesting feature in this case was the extreme difficulty of overcoming a shortening due to such young undeveloped muscles.

Ofttimes this injury is not only difficult to reduce, but in later youth difficult to hold in position. The fact that in extreme youth the epiphyseal line is curved makes maintenance of reduction easy at this age, but in later youth this line becomes practically transverse, hence the difficulty of holding the fragments when once reduced. When this is the case the arm must be dressed in partial or sometimes complete right-angle abduction

In all fractures near or through epiphyseal lines it is well to warn the parents of the patient that irregularities in growth may result. This may be in the form of deficient bony development or increased activity, resulting in early disappearance of the diaphyseal-epiphyseal line. This latter phenomenon I have noted in several cases—a condition about which I expect to make a later report.

*Follow-up Report*—The patient has a perfect result both anatomically and functionally, although it is yet too early (six weeks) to note any effect on growth.

**Case VI.**—This patient, Mrs. E. K., aged fifty-eight, slipped on the ice, fell upon her outstretched arm, and then struck full weight upon the shoulder, sustaining a comminuted fracture extending through the surgical neck, between the tuberosities, separating them both from the shaft, the fracture line entering the shoulder-joint. The case is one of interest because of the fact that the diagnosis, made by the physician who first saw her, was a dislocation of the shoulder which he attempted to reduce. On obtaining crepitus he desisted. She was then sent to her family physician, who referred her to us. Her first x-ray, which, unfortunately, has been lost, showed a wide separation of the two fragments composing the head and tuberosities, the greater tuberosity being pushed posteriorly, thus resulting in the flattened appearance of the shoulder that misled the first physician.

Under gas-oxygen anesthesia the separated fragments were molded together until the prominence of the shoulder was restored as much as possible.

*x-Ray Report After Reduction*—“Stereoscopic examination shows a comminuted fracture of the upper part of the humerus, essentially a fracture of the anatomic neck, extending between the tuberosities and down into the surgical neck.”

The fracture line running into the surgical neck is a faint one and shows little or not at all in the reproduced photograph (Fig. 69).

*Comment.*—The interesting feature of this case is the rational

explanation of the causative factors in this peculiar combination of fracture lines. The first part of the fall with the arm outstretched backward striking upon the hand resulted probably in the fracture across the surgical neck. Then when the patient turned and continued the fall, striking upon the point of the shoulder, the head was fractured.

*Follow-up Report*.—The patient states after ten months that she has a perfect functional result, being possessed of as



Fig. 69.—After reduction of the comminution

great excursion of movement as before the accident. She has no pain and no deformity.

*Conclusion*.—From the above cases we learn that the commonest error in diagnosis was in suspecting a dislocation. This was suspected in 4, and was present only in 2, in which 2 the fracture was not diagnosed until an x-ray had been taken. Two cases had to be operated upon because of interposition of tissue. Only one case had to be dressed in the abducted position, all others being dressed with the wedge-shaped axillary pad and the arm at the side of the chest. In none of the cases was painful

passive motion used, merely active motion and massage being employed. The patients were instructed to "climb the wall" with the injured arm, that is, to stand facing the wall and with the hand on the wall gradually work it up as far as possible, then turning with the injured side to the wall. This rapidly increases abduction at the shoulder, which motion is the one most often reduced or lost in these injuries. All the cases, with the exception of the fracture-dislocation treated palliatively, have perfect results.

## CONTRIBUTION BY DR J LESLIE DAVIS

ST AGNES' AND ST MARY'S HOSPITALS

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### THE CONSERVATION OF HEARING MADE PRACTICABLE BY THE TIMELY ELIMINATION OF NOSE AND THROAT DISORDERS

IN the assumption expressed in the title of this contribution there is nothing new, and therein lies at least one purpose of its selection.

A distinct peril growing out of the rapidly progressive scientific age in which we live is that of a more or less common, though perhaps unconscious, attitude of expectancy, a perpetual looking forward for something new, something better than that which we have, till the opportunities of today are largely neglected while longingly the disclosure of tomorrow's innovation is awaited.

There is no more striking example than the modern endeavors in the field of otology. None would deny that great progress has been made, that the knowledge of today pertaining to the physiology of the aural mechanism, the bacteriology and pathology concerned in its diseases, the recognition and appreciation of its symptomatology, and the applied technic in their treatment, as compared with only two or three decades ago, is worthy of commendable recognition.

When we consider, however, the small measure in which that knowledge has been put to practical use toward the prevention of aural disease and the consequent deficiencies in the sense of hearing, we can but as readily admit that an appreciation of our opportunities and obligations have been lamentably lacking.

Fully 90 per cent of all disorders of the ear are secondary processes, all of which are practicably preventable. The primary

or contributing factors are likewise as readily discernible and capable of elimination. Where then lies the blame for such a state of affairs? The oft-heard expression "so little can be done for deafness" contains enough of truth to be productive of immeasurable harm, but that it is largely fallacious should be pointed out and its detrimental influence obviated.

The appalling frequency with which deafness in some measure exists is seemingly but slightly appreciated even by so-called aurists, and least of all by the complacent victims of the insidious malady. And, furthermore, the average individual usually resents the implication of such affection until the defect has reached an advanced and probably irremedial stage.

Obviously, then, there should be inaugurated a campaign of education not only upon the prevalence of aural affections, and the characteristic insidiousness of their progressive development, but, most of all, upon the conditions which commonly render the aural mechanism susceptible to disease, and the fact that nearly all of those predisposing influences are capable of effective eradication.

One of the most variable characteristics of different disease entities, however, is found in the stage at which their symptoms or signs are first perceptibly manifested, and on that feature rests the principle and art of *practical* diagnosis and treatment.

That there, likewise, may be variableness both in the character and intensity of the symptomatology of the same entity is necessarily true, depending not only upon the type of either the primary or exciting factors but also, and largely, upon the incidence of disordered function from other factors and the measure of resistance possessed by the individual at any given period or age. And yet another phase is well expressed in the following words of Henry A. Christian. "It needs to be recognized that symptoms antedate signs and that the beginnings of disease may be present and productive of symptoms where no available method can detect abnormality in structure, and even tests of function record no change."

Sir James McKenzie has said: "The final and most important of all branches of medicine is the assessing of the value

of symptoms It is the knowledge of how to assess the value of symptoms that distinguishes medicine from all other sciences and all other branches of medicine" He further observes "The onset of disease in the body is invariably insidious and causes little disturbances to the economy and no visible sign of its presence"

In all cases where the susceptibility of any organ or structure to disease is known to depend upon the coexistence of certain primary and intermediary factors then the rational course is obvious anticipate the symptomatic manifestations and eliminate what experience has shown to be the most frequent potential factors, and do it at the earliest opportunity after their recognition

Probably in no other class of diseases could such a policy be more applicable than in that herein under discussion, where its processes are often not only of long chronicity before manifesting visible evidence of their existence, but which even on being detected, unless of marked degree, usually fails to impress the patient with any urgency for its eradication

With an adequate appreciation of the frequency of aural disease of the insidious nature of its development and its consequent unsuspected presence, one must readily see that the logical course of safety lies in the recognition and elimination of essential predisposing factors

Since the most common aural disorders are results of infection usually designated as otitis media, acute and chronic the chief problem confronting the physician is the determination of influences favoring its inception It must be remembered that under normal circumstances the tympanic cavity, ventilated by way of the eustachian tube, is accessible to the invasion of the same varieties and types of bacterial organisms as those to which the nasal passages and the paranasal sinuses are constantly exposed through the medium of inspired air Under normal circumstances these ever present bacterial organisms remain inert through an inherent immunizing property of cellular products, but they can become pathogenic to the degree of tissue injury or destruction in several different ways

(1) Through the reduction of tissue resistance; (2) through increased bacterial virility, (3) through the sudden invasion of extraneous organisms to which the tissues have not sufficient resistance to build up an effective immunity; (4) all three influences may be coexistent.

Acute infections of the middle ear occur most frequently secondary to acute infections of the nasal accessory sinuses, the ethmoid cells largely predominating. The presence of pharyngeal obstruction by adenoids in children greatly increases the incidence of aural suppuration, but without the coexistent sinus infection its potential influence is greatly reduced.

The majority of acute infections are apt to be accompanied by sufficiently painful, or at least uncomfortable, early manifestations to cause the victim to seek relief, in which warning nature is kind to the patient, but, at the same time, imposes an obligation upon his physician.

By far the greater number of cases of defective hearing, however, do not develop with such perceptible evidences of their incipiency, but are the result of the so-called chronic catarrhal type of middle-ear disease and, unless detected by the examiner, is apt to reach a stage of more or less irreparable tissue change in the aural structures before the patient is aware of its presence. This particular type of aural disease was considered in greater detail than the present objective will permit in my paper, "Defective Hearing: Its Early Origin, Contributing Causes, and Practical Measures of Prevention," The Therapeutic Gazette, December 15, 1920. I quote the following paragraph: "Those insidious influences which have been mentioned as usually of long duration before the patient is perceptibly aware of auditory interference sufficiently to seek relief, and which are then found to have developed beyond the stage where restoration might have been practicable, are by no means difficult of detection when once the processes concerned are understood, so that by anticipating the results while we so clearly see the causes at work the next generation can, in a great measure, be spared an affliction from which so large a percentage of the present now suffer. Thus we might safely conclude that responsibility of

hearing rests heaviest upon those who are most frequently called upon to treat the various discomforts and diseases of childhood, or on those who in any official capacity may have opportunities to make occasional record of the physical status of children To be prepared then, for effective efforts against the development of this treacherous malady there must of necessity be a general recognition of the important pathologic agencies concerned, and a concerted movement toward their elimination "

In a previous contribution to *Surgical Clinics of North America*, February, 1923, under the title "Frequent Effects of Morbid Tonsils Not Commonly Recognized" the following reference is relevant to the present discussion

"The first class of cases I shall designate as *disturbances of regional circulation, interfering perhaps, with nutrition and elimination and causing disordered function of certain highly sensitized and specialized tissues* The most common example of this condition may be observed in the very familiar appearance of the membrana tympani in the chronic dry form of catarrhal otitis media The transformation from the normal translucent lustrous membrane is usually a very slow process, the earliest detected macroscopic appearance being a faint cloudiness or fogginess which unless intercepted may grow gradually more and more dense and lusterless till its eventual appearance is not unlike ground glass, or in some cases it partakes more of a creamy or ivory like appearance This condition frequently designated as 'thickening' of the drum membrane, I am convinced is due to the protracted influence of morbid tonsils in a large majority of cases It is a phenomenon to which I have paid particular attention for many years, and never have I found the aural condition without the presence, unless previously removed, of diseased tonsils I have watched the slowly progressing character of the clouding over a period of many years where the cause was not removed, and I have not seen with but few exceptions, any perceptible further advancement of the process after enucleation of the tonsils many cases having been examined as long as ten to fifteen years afterward I know of no measure, however, that will restore the normal translucency and luster

of the membrane or remove the clouding or thickening in the slightest degree when once the change has occurred. Such alteration in the drum membrane, of course, is not the full extent of damage, but is usually associated with structural changes in other parts of the aural mechanism—the combined effect of which usually brings about defective hearing varying in degree according to the extensiveness and intensity of the disease. There is little doubt that a large percentage of so-called deafness of old age would have been obviated by the timely removal of a tonsillar focus of infection."

Space would not permit of further detail regarding types of aural disease except at the expense of the consideration I wish to devote to certain phases of the pathologic agencies concerned in the predisposition to those diseases.

Of the nasal abnormalities which play an important rôle I wish to lay particular stress upon the congenitally malformed middle turbinates, which, when later supplemented by the associated toxic influence of diseased faucial tonsils, I believe can be shown to represent a more potent noxious influence than any or even all other intranasal abnormalities.

In the current issue of *The Therapeutic Gazette* I described this dual pathologic agency in considerable detail under the title, "Latent Evils in Congenitally Deformed Middle Turbinates, Later Manifested When Supplemented by a Focus of Chronic Infection."

The type of turbinal abnormality referred to is usually a unilateral hyperplasia of the body of the structure, with a corresponding deflection of that portion of the nasal septum directly opposite, with a correlative underdevelopment of the opposite middle terminal. The septal deflection involves essentially the perpendicular plate of the ethmoid, and the whole abnormality is conceived to be an embryologic deviation fixed by heredity.

The enlarged and malformed turbinal does not represent an hypertrophy, but is, in reality, deficient in every phase of function with which the normal structure is endowed. Its chief pathogenic influence exists in its position of fixed rigidity with

constant pressure against the ethmoidal wall, and not upon its relation to the septum. Contrary to the usual impression, the surface of the turbinal is rarely in contact with the septal wall, and then only during periods of turgescence of the mucosa, which is not constant. Another pathogenic influence of this type of abnormal turbinal is that of obstruction to the infundibulum, interfering with ventilation of the sinuses. An important factor to remember in the surgical elimination of this malformed structure is that its thickest portion is found near the junction of the middle and posterior thirds, so that the common procedure of resecting the anterior end of the turbinal leaves the most offending portion still in its malposition, besides favoring the accumulation of crusts and deflecting the current of inspired air from its normal course. My own procedure for the past sixteen years, where the resection of any part of such a middle turbinal was indicated, has been its complete and clean extirpation, which has been productive of most satisfactory end results.

I have described this type of malformed turbinal because of the frequency with which I have found it associated with a common type of vertigo and dizziness, in which cases the symptoms have uniformly subsided following the removal of the obstructing turbinal. These conditions were always further affected and aggravated by an associated toxic influence from septic tonsils, which were also removed at the same time as the turbinal.

These cases of vertigo have been of extreme interest from the standpoint of an effective measure of relief, for while a great deal has been written in recent years regarding vertigo, to the end of attributing its occurrence to vestibular disturbance, the discussions have seemed to end with the establishment of a diagnosis, without offering any measure for its relief.

An existing tinnitus, of distressing degree, has also been relieved in a number of cases where the malformed turbinal was removed for some other purpose. There is no doubt that one of the most important measures in the treatment of acute otitis media is the establishment and maintenance of the freest

possible nasal respiration and sinus ventilation, a condition which can best be accomplished by combined systemic and local measures, and it naturally follows that the permanent maintenance of a state of freedom from nasal impediments would be no less important as a prophylactic measure.

One of the most important steps, then, in the prophylaxis of aural disease is the correction of such nasal abnormalities as interfere not so much with the normal channels of inspired air as with the normal ventilation of the accessory sinuses.

Drainage of the sinuses is a matter of physiologic pathology rather than normal function, and under conditions of efficient ventilation and normal resistance of the mucosa to infections there should be no occasion for any accumulation within or any drainage from any sinus cavity.

Likewise any mucous or watery discharge from the nose is indicative of a catarrhal process or reflex phenomena, and is abnormal notwithstanding a popular impression to the contrary.

A mother one time brought her young child to a dispensary clinic of which I was in charge, and announced, in broken English, "I have tree older children home who have alvays some stuff run from de nose, dis one he don't have it; I vant you tell me vat's matter mit him." She had brought her only well child to the clinic and left at home three that needed treatment, as further investigation revealed. I fear there are a good many others of a higher degree of intelligence than that poor woman, who unconsciously draw equally as fallacious conclusions on the basis that the majority must represent normality instead of realizing that, as has often been said, "rarely is the majority right."

Valuable as is the recognition of the influence of intranasal abnormalities and diseases on the etiology of aural disorders, but little progress is possible without due appreciation of the fact that the nasal factors represent largely an intermediary influence, depending frequently and principally upon a primary focus of chronic infection which has supplied the element of reduced resistance.

In the great majority of instances this factor is supplied by chronically diseased tonsils.

In an article published in The Pennsylvania Medical Journal in December, 1915, under the title "Ethmoiditis Its Varied Effects and Their Probable Prevention" I wrote as follows "It is not improbable that more people suffer varying degrees of defective hearing from what is usually termed 'catarrhal' infections than from any other cause, unless we except faucial and pharyngeal tonsils, and even they in numerous instances, are in a large measure to blame for the sinus disease I cannot pass this opportunity of saying that whatever indictments may have been filed against these chief of toxic offenders the tonsils, they have yet to receive their full and just condemnation'

I would still make the same statement today, nine years later, but with increased emphasis

Regarding the rôle which is played by chronic sepsis of diseased tonsils there seemingly are still some gross misconceptions Disturbances of function attributed to tonsillar influence are rarely due to actual secondary infection, but are rather the result of a disordered chemistry of secretions through contamination by the products of infection at the site of the septic focus

Granting that the primary source or contributing influence of a disease process within the ear is tonsillar sepsis, what processes or stages would probably intervene between the source and the eventual aural symptom?

Start with the early existence of an infected focus within the faucial tonsils the first disturbance is within the tonsillar crypts themselves, where, from certain bacterial processes, there is developed and accumulated a poisonous product, the first outside contamination occurs in the saliva, since the tonsil is so constructed and so situated anatomically with reference to muscular relations that with every act of swallowing the organ is compressed from all directions toward its free oral surface on which the crypts open, thus emptying some measure of its polluted contents into the oropharynx, to be swallowed with the saliva alone or in combination with food The cheesy concretions so often found occluding the cryptic openings in the free surface of the tonsils, or more abundantly in the larger, deeper, confluent

cavities in certain markedly morbid tonsils, are probably less septic and harmful than the liquefied contents. They seem more in the nature of coagulated residue after the more actively septic soluble content has been disposed of, partly by expression into the oropharynx and, to a more or less degree, through absorption by the lymphatic and arterial circulations.

There is started, simultaneously, then, two or three distinct channels of distribution of the released poison, which, depending upon its toxic potency, will affect functions and tissues accordingly, the probability, of course, being that in the early period of a chronic focus it will act as a mild, constant, insidious, though cumulative poison.

I say cumulative advisedly; for while the processes of resistance and elimination may for a time be capable of neutralizing and throwing off a mild irritant, yet under the influence of a poison continuously supplied the neutralizing and excreting organs gradually become more and more hampered in their functions. According to my observation for many years, and as stated on previous occasions, the earliest, most common, and most persistently constant effect of the poison emanating from diseased tonsils is exerted upon the liver in a manner deleterious to the detoxifying properties of the gland.

But coexistent with this perhaps more obviously deranged function in one organ there develops automatically a common disturbance in metabolism and in altered function of most of the other organs, each becoming more and more affected through the insufficiency of the others, ending in a state of general functional imbalance.

The patient at this stage is now susceptible to whatever internal or external influences may be added, and if the exposure be to additional bacterial agents not found in the original tonsillar source, those bacteria are rendered more potent in their attack because of the favorable soil produced through lowered resistance.

Patients, and not infrequently their physicians, are oftentimes dubious regarding their tonsils being the primary cause of many common diseases unless they can associate the disease

with a previous tonsillitis "I have never in my life had trouble with my tonsils (by 'trouble' meaning tonsillitis or quinsy), so how could my tonsils have anything to do with what I am suffering now?" is a frequent argument spoken in good faith by many patients. It can be stated with positive assurance that the common form of chronic morbid tonsil—the type most active in the etiology of so many diseases, is rarely, if ever, a product of repeated attacks of acute tonsillitis, and that the most highly noxious type of tonsil in young or old might never have been involved in an acute infection at all.

Another fallacy occasionally encountered, where the removal of tonsils is not followed within a seemingly reasonable length of time by cure of the disease from which the patient suffered, is that if the diagnosis were correct the removal of the tonsils should have cured the disease. The error in deduction is, of course, the overlooking of the intermediate progressive steps and perhaps long period of time between the infected focus and the occurrence of the ultimate symptoms of which the patient complained, each step being an intricate process in itself, while the complexity grows with each new function disturbed or organ injured. The degree of possible recovery, then, from an injury arising in the course of chronic infection, after the primary cause is removed, will be in proportion to the functional integrity of all the remaining organs and all the elements of resistance, and one of the amazing revelations brought out by modern treatment of focal infections is the marked functional resiliency in many cases of organs which had long remained inactive.

From this standpoint, then, it is obvious that any characteristic signs or symptoms, such as the various shades of color observed on the anterior pillars, which may seem to identify certain tonsils with certain definite types of secondary disease processes, must fail largely to be of practical value.

Moreover, even if the indications were reasonably accurate it would not alter the indications for the removal of the diseased tonsils, for regardless of the predominant type of bacterial organisms with which a tonsil may be infested (strepto-

coccus, pneumococcus, or staphylococcus), it is always a potential, if not already active, factor in various functional disturbances.

It is, then, from the standpoint of both primary and intermediate influences that the effective prophylaxis of aural diseases can be made practicable. To that end preservation of the sense of hearing is a commission of the entire medical profession and of no less importance than that of any other problem to which its forces may be marshalled. Especially is this true when it is realized that the most potent measures which count for the integrity of the aural mechanism are of equal merit toward promoting the highest degree of so-called public health, and the maintenance of public health may be considered successful only so far as the nearest possible approach to normality of all physical and mental functions is attained.

Instances of ultraspecialism, while capable of developing certain advantages in technical manipulation, have not been unproductive of evil. A specific example of undesirable influence will be found in the not uncommon practice in some of the undergraduate medical schools of maintaining a department of instruction in Otology, separate from that of Rhinolaryngology. Separate dispensary clinics for these two departments is not unproductive of misconceptions in the students' minds, relative to aural treatment and, likewise, in decreased effectiveness in the end-results of the conditions treated.

Otology, then, strictly speaking, as a specialty is untenable, since the greater part of the treatment of nine-tenths of all ear diseases consists in attention to nose, throat, and systemic disorders.

A striking example of inappreciation of the relative importance of local and systemic factors in disease occurred in my practice only a few months ago. I was called in consultation by a general practitioner of at least several years' experience to see a seven-year-old child who, following an acute suppurative middle-ear infection, showed manifestations of beginning mastoid involvement, with temperature of  $103^{\circ}$  F. The doctor outlined the character of treatment he had instituted, all of which was

directed to the ear, and was in accordance with commonly approved local technic. My order of examination was to inspect first the child's nostrils which were found markedly engorged and filled with mucopus, next I started to examine the throat, but noticing a very heavily coated tongue I asked concerning the condition of the child's bowels, whereupon the doctor turned to the child's mother for the information and received the reply "His bowels have not been moved for four days, doctor!" An immediate enema was ordered followed by calomel and saline, local shrinkage of the nostrils was instituted and a hypodermic of mixed stock vaccine of the pneumococcus streptococcus-staphylococcus combination was given instructions regarding further treatment were outlined and the child promptly recovered. There is little doubt that had the physician applied rational systemic treatment early in the course of the nasal infection there would not have developed an aural complication at all. The child's tonsils were enucleated a few months later.

Even with a limited appreciation of the latent evils existing in certain previously supposed isolated and confined foci of infection, our whole concept of the practice of medicine naturally has been changed, bacteriology has become a new science and pathologic physiology recognizes the still reclaimable morbid organ.

The newer conception of the behavior of microbial organisms, constant and variable singly and combined confined and released, has interpreted many misconceptions of etiology, given new values to symptoms and signs and established new principles and methods of diagnosis and treatment.

Thus in the gradual evolution of principles of practice in aural disease it is interesting to note how various measures and manipulations which formerly were commonly in use have been discarded. I have not used inflation of the middle ear either by use of a Politzer bag or by compressed air for ten years, I have not introduced a catheter or a bougie into the eustachian tube for a like period, and all vibratory apparatus was discarded long before the other paraphernalia. But with the gradual laying aside of these strictly aural devices I have paid more

and more attention to the treatment and elimination of contributing factors, found principally in disorders of the nose and throat, with amazingly increased satisfaction in results.

Two notable features denoting increased efficiency is the promptness with which acute otitis media can be checked in its early stages, while formerly common complications are exceedingly rare. In the past ten years the number of mastoid operations that I have done is just 4 per cent of the number of the preceding decade. Only one of that 4 per cent. was seen till the mastoid involvement was in an advanced stage, and applying the same principles of treatment as usually employed in uncomplicated otitis media in connection with the mastoid operation, each case made prompt and satisfactory recovery.

The aural mechanism is so delicately constructed and so highly sensitized that if the offices of the physician be largely confined to the competent protection from extraneous interferences, the functional integrity of many ears doubtless will fare infinitely better.

## CLINIC OF DR TEMPLE FAY

UNIVERSITY HOSPITAL

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### PROBLEMS OF CEREBROSPINAL PRESSURE<sup>1</sup>

PERHAPS the most disturbing and constant factor in most cases of brain tumor is the increase of intracranial pressure that sooner or later manifests itself in the symptoms of head ache vomiting failing vision, and stupor Any or all of these symptoms may be seen in a given case depending upon the extent and duration of the pressure

We shall see that whether or not it is possible to remove the cause, it is essential to relieve the pressure, so that the condition giving rise to increased tension may be more safely dealt with

The cases we have selected for you have suffered from all of the foregoing symptoms but each one illustrates the exaggeration of one of these symptoms above all others

The first case is one of great interest from several aspects The patient (S. L.) thirty two years of age came into the hospital complaining of "severe headache and nervousness" Nine years ago he had a jacksonian convulsion of the left side, leaving him unconscious for some time He has had about eight or nine attacks since that time occurring about once a year Attacks start by a feeling of weakness in the left knee, which spreads rapidly up the left side and terminates in a convolution, leaving the patient unconscious

He has had no loss of sphincteric control, he has bitten the tongue during an attack

For the past six weeks he has had violent frontal headaches, at times causing him to roll on the floor with pain

<sup>1</sup> From the Neurosurgical Service of Dr Charles H Frazer University Hospital Philadelphia

Attempts to control the headache by drugs were of little avail, and morphin in large doses was the only means of relief at first. Later he was placed on large doses of magnesium sulphate daily, with striking results—the headache was at once relieved and the patient remained perfectly comfortable, making physical examination and neurologic tests possible. A brief summary of the positive findings are:

Blood-pressure 120/70

Slight exophthalmus, bilateral.

Spasticity of both extremities on the left.

Fingers flexed—left leg is dragged in walking.

Slight weakness of right external rectus.

Swelling of the disks of right eye of 4 diopters, of left eye of 3 diopters

*No other cranial nerve involvement.*

Spasticity of left arm and leg

Patellar and ankle-clonus and Babinski on the left.

Asteriognosis and loss of sense of position in left hand.

No sensory or other motor disturbances.

x-Ray pituitary measurements, A P 10; depth 10.

Lumbar puncture—50 mm. Hg., no fluid taken.

3/14·22 *Diagnosis* of tumor in the right motor area, extending into the parietal lobe, was made.

Operation by Dr. Frazier—25 c.c. of yellow gelatinous fluid withdrawn—equal quantity of air injected.

Pneumogram taken.

3/21/22. Secondary operation, Dr. Frazier—Cyst opened and small gliomatous nubbin removed

4/16/22: Discharged after full radiation.

11/12/23. At the present time he has regained the use of his left arm. The left leg is still slightly spastic.

Stereognosis, dysmetria, and sense of position have become normal on the left.

Patellar and ankle-clonus have disappeared. He still shows a Babinski. There has been no return of headache to date.

He returns after twenty months without recurrence of symptoms and apparently in normal health, to receive further radia-

tion The interesting feature to us here is the prompt temporary relief of pressure afforded by means of magnesium sulphate solution until operative intervention removed the cause and gave him permanent relief

The next case is one where almost persistent vomiting has given grave cause for worry, as the patient has been unable to take food of any kind for several days, and the case is one where much time and study was necessary to establish a definite localization

A G, thirty five years, is a woman who first noted three months ago failing vision and the loss of the sight on her right side, so that as she walked along the street she would bump into objects on her right Aside from occasional headaches, failing vision, and the persistent vomiting she gave no other complaint

The neurologic findings briefly were few of a positive nature There was loss of the sense of smell on the left side Left homonymus hemianopsia, choked disks of 3 D Reflexes were all slightly exaggerated, but equally so There were no other localizing phenomena Following lumbar puncture in another hospital in which 15 c c of fluid was withdrawn, she developed subjective numbness in the left hand Adiadookinesis and loss of the sense of position and stereognosis on the left

The problem of checking the vomiting and reducing the intracranial pressure was important in this case, and as she was unable to take magnesium sulphate by mouth it was given by bowel Following two injections the vomiting ceased and the patient's condition became transformed into one of comparative comfort, and the Bárány and other tests were carried out By a process of elimination and the positive findings that were at hand, a diagnosis of pituitary tumor was made, and a trans-frontal exploration done A large tumor originating in the region of the pituitary was found extending under both frontal lobes, more marked on the left side

The third case proved to be one of great difficulty in localization, and showed a large lesion with comparatively few symptoms

A. E., age twenty-six, came complaining of morning headaches for the past three years that have become less severe of late. Pain in the left side of the head for the past six months. Slight tinnitus and deafness in the right ear. Failing vision has been rapid and progressive. While under study on the Neurological Service and in order to preserve her eyesight she was placed on magnesium sulphate, with the following results

8/1: Eye examination: Pupils normal, choked disk. Disk surface elevated about 7 or 8 diopters. Edema extends well out into the retina. Vessels very tortuous. No hemorrhages seen. (Dr. Williams.)

8/4: Dr. Shumway reports: Level of the right disk is 9 D., level of the left disk is 8 D.

8/7: Dr. Shumway: Right disk 9 D. Left disk 7 D Practically no change.

8/21: Two rectal injections of magnesium sulphate.

8/23: Two ounces magnesium sulphate. Repeated in two hours. Six stools.

8/26: Two ounces of magnesium sulphate. Four stools.

8/29: Eye report: Choked disk 7 to 8 D.

9/4: Patient is taking magnesium sulphate 2 ounces each morning. She has from three to four bowel movements a day. She does not seem to be suffering from any ill effects therefrom.

9/5: Eye report: Choked disk, right eye 4 D., left eye 4 D. (Williams.)

9/10: The patient thinks that she is seeing a good deal better at present. She takes 2 ounces of magnesium sulphate each morning About three bowel movements a day Watery in character.

9/10: Eye report: 4 D. in both eyes. (Baer.)

9/17: Disk swelling 6 D. each. Decided pallor.

9/22: Choked disk, right 8 D.; left 7 D.

Transferred for operation.

For a period of one month the vision improved and the disks partly subsided; later the disks showed signs of pallor and the return of swelling, so that operation was imperative.

The positive physical findings were bilateral loss of sense of

smell. Right eye no light perception, slight consensual light reflex remains, concentric loss of the fields in the left eye more marked on the nasal side. Bilateral choked disks of 8 D. Lateral nystagmus when looking to the right or left. No other cranial nerve disturbance except slight diminution of hearing on the right side. (Report of ear clinic, chronic otitis media) Slight



Fig. 70.—Large cerebellopontile tumor which gave few symptoms of localization and x-ray evidence of a tumor in the region of the pituitary

inco-ordination and inclines to stagger to the left. *No motor or sensory disturbances.* Reflexes active, equal, and normal. x-Ray pituitary A. P. 11, depth 12, otherwise negative for head. Slight atrophy of the posterior clinoid processes, ventriculogram showed enlargement of the ventricles, but no distortion

The pituitary region and third ventricle was suspected and

a transfrontal exploration made, but no tumor presented. Later a large cerebellopontile tumor was found on the right side almost the size of a lime (Fig. 70).

The next case is a sad but interesting study of intracranial problems, and illustrates the last symptom in the advance of tumor, namely, stupor.

This little patient (C. S.), age eight years, was admitted in a stuporous condition. The father gives the following history: Four months ago the child began to have headaches which were associated with projectile vomiting. His eyes failed rapidly and he developed an extracocular palsy. Two months ago he developed weakness in the right arm and leg, and lately there has been weakness on the right side of face. He has had no convulsions.

Physical examination shows a well-developed child who appears quite stuporous. He is roused with difficulty and speaks with difficulty. He is unable to walk and the sight is very poor. Bilateral choked disks of 5 D. The right side of the face, right arm, and leg are paralyzed. The head shows a large, smooth, hard, bony bulge over the region of the posterior fontanel, easily palpable and shown by x-ray (Fig. 71). Face shows complete paralysis of the right facial nerve, the left seventh shows good power. Eyes: Marked exophthalmos and strabismus paralytica. Pupils are widely dilated, do not react to light. Veins very full. Upper extremities, right flaccid palsy. Exaggerated reflexes, slight muscular atrophy. Left hand and arm show good power, prompt reflexes. Lower extremities: Right leg completely paralyzed, patellar and Achilles' reflexes are markedly exaggerated. Ankle-clonus and Babinski present. Left leg, slight weakness, increased patellar reflex, no Babinski or ankle-clonus.

On the night of admission, as the stupor was well developed, stimulation of camphorated oil was given, and 2 ounces of saturated solution of magnesium sulphate was introduced into the rectum; 1 ounce of magnesium sulphate given by mouth, to be repeated every fourth hour.

After several minutes he roused from stupor, the pulse became normal, and respirations rose to 20.

The following day the child was awake and answered questions. The pulse-rate varied from 120 to 80, but the respirations were well up between 16 and 20. Spinal puncture showed a pressure of 50 mm. Hg.

The second day there were no attacks of stupor. Spinal pressure has fallen under magnesium sulphate to 30 mm. Hg.



Fig. 71.—x-Ray plate showing large osteosarcoma of the vault, this was found to be associated with a huge cerebral tumor, just below and extending to the left of the midline

The patient was maintained for twelve days until in condition for operative intervention and decompression over the tumor mass, which was disclosed as a huge growth, sarcomatous in type, lying just below the bony tumor noted on the head, and in the midline, with more extension to the left.

These cases, we feel, serve to illustrate the control of the cardinal symptoms of headache, vomiting, failing vision, and stupor in tumors of the brain by the use of magnesium sulphate in sufficient doses.

### ACUTE TRAUMATIC LESIONS

Of the greatest concern to the general surgeon and practitioner are the cases which are seen following some acute injury to the head, and present a very different picture from those we have just demonstrated. We shall see that although the mechanism is different, the effects are similar, but far more acute, and we, therefore, wish to give our methods of treatment of intracranial pressure arising in cases of acute traumatic injuries which are frequently admitted to our wards.

From the standpoint of treatment the cases may be divided into three classes:

1. Those cases with or without fracture of the skull showing contusion or concussion, with brain symptoms which are more or less generalized.

2. Those cases with or without fracture of the skull showing symptoms of severe brain injury plus profound shock from loss of blood, or other bodily injuries:

3. Those cases which show localizing symptoms from middle meningeal hemorrhage, or symptoms at the site of the injury or contre-coup.

In dealing with fracture of the skull we all agree that compounded fractures and depressed fractures call for immediate surgical intervention, providing the condition of the patient warrants the procedure. At least surgery may be attempted as soon as symptoms of shock have been adequately treated.

In considering compound fracture and depressed fracture we have here a local problem to deal with, and, aside from the thorough cleansing of the area, and removal of impinging bone fragments or the elevation of a depressed fracture, there is little else to be considered.

However, in considering the other two classes of brain injury, we face our most difficult problem, and we shall take that up regardless of the existence of a fracture of the skull, its character, or extent. In considering the first class of brain injury, of course, the most important feature and aside from the ordinary antiseptic care of lacerations, or comminuted fracture, the outcome of the case will depend upon the proper manage-

ment of intracranial tension which is sure to manifest itself within a short time. In these cases dehydration is important, that is, as the brain swells within the cavity something must be removed in order to maintain the vital functions which become depressed by pressure. Whether you institute intermittent spinal drainage decompression over a large area, or administer dehydrating agents in the way of magnesium sulphate solution, it makes little difference perhaps in the final outcome of the case. Certain it is, added space must be given for the swelling which occurs in the cerebral tissues and perhaps the increased ventricular fluid secretory function which occurs. We have found dehydration to be the most conservative and dependable method of treating these cases.

We will turn first to the type of case in which cerebral trauma alone dominates the symptoms and condition of the patient. In this type of case there may be simply concussion due to a blow, or striking of the head suddenly against some unyielding object. Fracture of the skull may or may not complicate this group. It is necessary to definitely have in mind the symptoms presented by such a patient so that in considering the next group no confusion of treatment will ensue.

When you find a patient who has suffered from a severe head injury, there are certain examinations and tests required to establish the extent of the cerebral trauma. In cases where consciousness has not returned within an hour or less careful inspection of the head should be made to determine the point of the impact, and if lacerations are present, these should be inspected to ascertain if a fracture of the skull is also present. The part should be prepared and a sterile probe inserted. If any of the cranial bones are evident, sometimes a small fracture may be immediately detected by scratching over the surface of the skull and noting any irregularities as they occur.

The examinations of the eyes, nose, and ears for the evidence of bleeding or cerebrospinal fluid leak is most important. When encountered in the ears or nose, gentle packing with sterile cotton, and in the case of petrous bone fractures at the base, a small pledget of cotton dipped in dichloramin T is placed

in the external auditory canal. This is a wise safeguard against possible meningitis.

A careful neurologic survey as to reflexes, existing paralyses, motor or sensory aphasia, is, of course, routine. The most important factor, we feel, lies in the pulse, temperature, and respiration charts which should be started immediately and maintained at half-hour intervals for the first twenty-four hours. Blood-pressure readings also should be taken at the same time, and the pulse pressure determined and charted from this.

All the cases are routinely given magnesium sulphate by mouth or bowel at four-hour intervals for the first twelve hours. Spinal puncture should be made to determine pressure and to ascertain presence of blood in the spinal fluid. If the pressure is above 15, no fluid should be taken.

#### x-Ray of the head should be made as soon as possible

With this information at hand, one can intelligently treat acute cases of cerebral injury in one of several ways. Wherever a case shows localizing symptoms, such as paralysis, convulsions or aphasia, or middle meningeal hemorrhage is suspected, decompression is at once indicated. However, you will find the greater majority of these cases show varying degrees of stupor, cerebral excitement, and increase in intracranial tension, indicated by vomiting, reduction in respiratory and pulse-rates, with an associated rise in temperature readings. It is in this group of cases that active use of salt solutions by bowel will yield to treatment of this nature without operative intervention, and it has been the practice of this clinic in the past two years to use this method in preference to the old routine subtemporal decompression, with the result that in the past two years there have been only three decompressions for cerebral injury, and in these localizing symptoms were evident. It has been our experience that cases showing profound unconscious states, or those of extensive cranial injuries, succumbed in spite of any means of treatment now at our disposal. We do feel, however, that we have eliminated the added risk of operative intervention and shock in the more conservative treatment by the use of salt solutions, and as Dr. Grant will show in his clinic the method

is more effective and there are several cases which we can definitely feel survived because of this treatment alone

The picture so frequently seen in cases of concussion with the so called medullary edema is shown in Fig 72, and serves as an index to follow in cases of this character. At the time respirations are noted to be falling especially upon reaching 14, active intervention must be considered, and it is at this

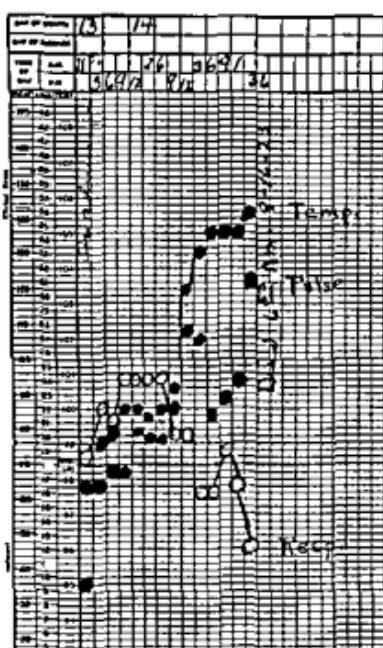


Fig 72—Chart of patient showing at first profound shock and later medullary depression. The patient never regained consciousness after falling 30 feet to the pavement where he remained und covered for some hours (Note initial low temperature rising pulse and respiration seen in shock.)

point that your magnesium sulphate solution will help restore the picture to normal. Fluid intake must be limited in these cases so as not to defeat the purpose of dehydration. Often times the temperature rise may be broken by a small dose of phenacetin. With fixation of the head and sedatives, avoiding morphin when possible because of the respiratory depressant effect, the case may then be treated symptomatically.

The second class of cases, showing profound shock as an

added factor, must never be dehydrated in the initial stages, for here it is not the immediate brain injury that is most important, but the general vascular depletion, either by direct hemorrhage or "surgical shock," associated with a marked vasomotor collapse, giving rise to the depletion of blood volume by transudation of the plasma into the capillary spaces, and in sweating;

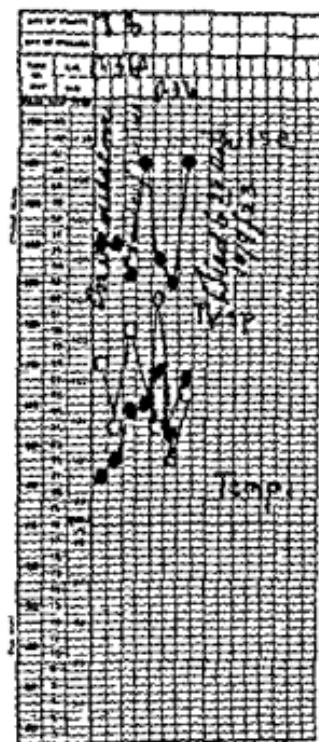


Fig. 73.—Chart of extreme case of shock and concussion seen in a child brought into the hospital six hours after 40-foot fall from a railroad bridge in which loss of blood from lacerations was a complication. Patient never regained consciousness and failed to react to all stimulation and treatment.

thus becoming unavailable for circulatory function. Here the primary treatment should be directed toward the restoration of blood volume, and when reaction to shock occurs, then the intracranial condition may become the uppermost factor in the successful treatment of the case.

In this second type of case there is presented the picture of profound shock, as well as concussion with or without frac-

ture of the skull, the term "shock" here being used in the surgical sense (Fig. 73), the patient being unconscious or delirious when first seen, the pulse rapid, the temperature subnormal, the respirations increased, the skin cold and "leaky." Here active treatment for shock must be considered above all things. The patient should not even be subjected to a physical examination aside from a cursory survey. Heat should be applied at once and a shock cabinet placed over the patient if this is available. The clothes should not be removed for fear of exposure and cold, the patient should be placed in a warm bed with as little handling as absolutely necessary. Hot fluids, stimulation, and sedatives here are indicated, and morphin given if necessary. This, however, may obscure your respiratory picture, and other drugs—such as bromids—by rectum in large doses, scopolamin, and codein are to be preferred. Morphin, of course, must be given when necessary.

Frequent blood-pressure readings may be taken without disturbing the patient. A frequent temperature and respiratory chart should be kept. Further examination should be postponed until the temperature reaches normal and the pulse has shown a stronger and more normal aspect. After this initial phase of shock has passed, a thorough physical examination and neurologic survey should be made to determine possible localizable lesions. x-Ray and lumbar puncture may now be done, and a decompression, if a localized lesion is determined.

As the period of shock wears off, attention must be directed to intracranial tension which is sure to rise, and this may be combated, now that the immediate danger of shock has passed, by appropriate and sufficient doses of hypertonic salt solutions.

Dehydration may safely be carried out from this point on, as the urgency of the case may demand. Ventricular puncture and repeated lumbar puncture may also be resorted to if necessary. The latter procedure is not without danger when the pressure is increased, due to the possibility of sudden foraminal hernia.

It will be evident that should this type of case be treated at once for cerebral injury, dehydration would but accentuate

the picture of shock which is manifest from the start, and the

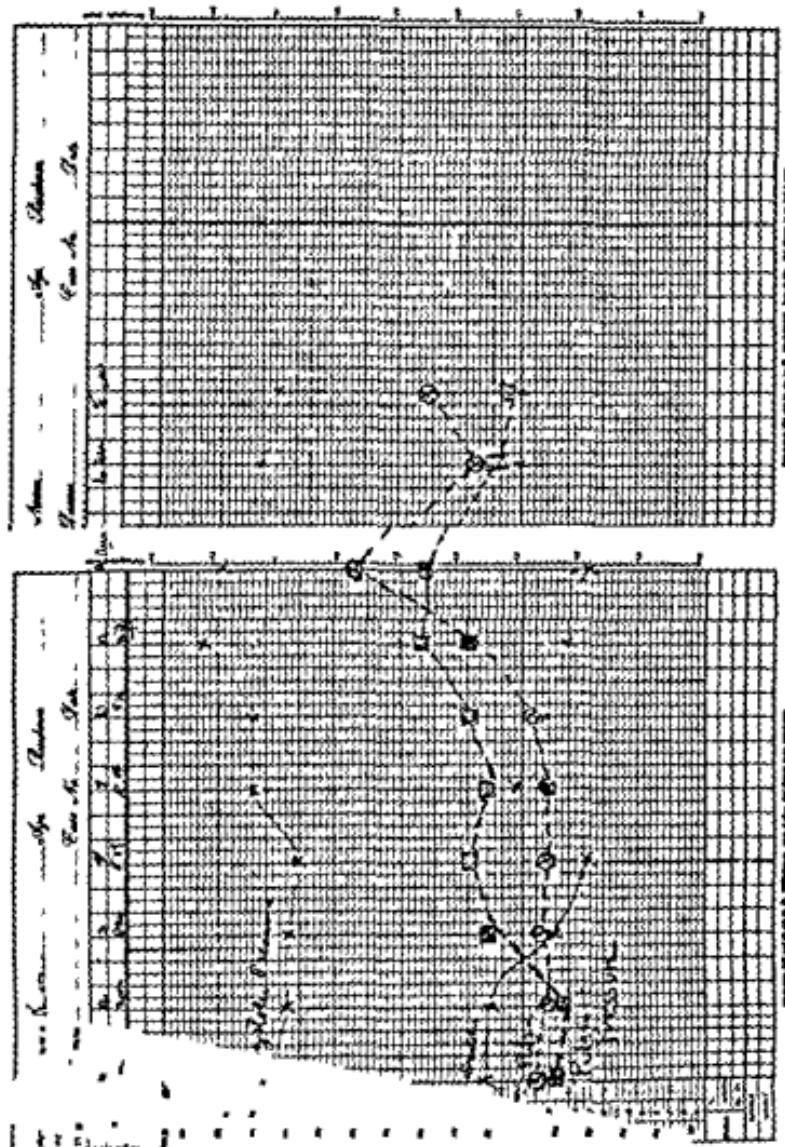


Fig. 74.—Chart of patient 811, in which the pulse pressure and pulse lines have . Impression in . After adequate dehydration the lines again cross with a return to the normal, making unnecessary the old method of decompression

patient would promptly succumb. It is, therefore, quite essential to distinguish these two types of cases in order to insti-

tute the proper means for relief. Blood pressure readings will throw great light on the vasomotor condition of the patient, and stimulation may be necessary to avoid a rapidly rising pulse pressure. The old axiom—"when the pulse pressure crosses the pulse rate is the time for decompression"—need not occur, for if dehydration has been adequately maintained, as is shown in (Fig. 74) where the lines have recrossed following the active dehydration decompression is unnecessary.

#### INTERMITTENT INCREASE IN CEREBROSPINAL PRESSURE

A few cases following the fracture of the skull have been noted in which the patient has suffered from attacks over a period of months following his injury in which he may complain of severe headache, occasionally associated with vomiting, and it will be noted that the pulse and respirations during these attacks show a rapid fall. The patient (W. I.), twenty three years of age, who received a fractured skull seven years ago, and comes complaining of attacks of headache and vomiting will illustrate this point. Aside from some irregularities of the occipital bone, neurologic and physical examinations were entirely negative, but, as you will see from his chart (Fig. 75), he suffered from a fall of respiratory rate to 16 and pulse rate to 60, when attacks of headache and vomiting occurred. It is hard to explain cases of this nature except on the basis of intermittent acute internal hydrocephalus which is probably due to some obstruction at the base, and in some way, after a short time, relief of pressure is obtained through normal channels. Two points of interest about the study of this case are the facts that spinal puncture revealed a pressure of only 2 mm of mercury upon pressure over the jugular veins, in making the Queckenstadt test, the manometer registered a rise to only 4 mm, whereas a normal rise of 20 to 30 may be obtained. It seems evident that some block has occurred between the ventricles and the lumbar region. When phenolphthalein was introduced into the right ventricle it was obtained within forty-five minutes from the lumbar needle, showing that between

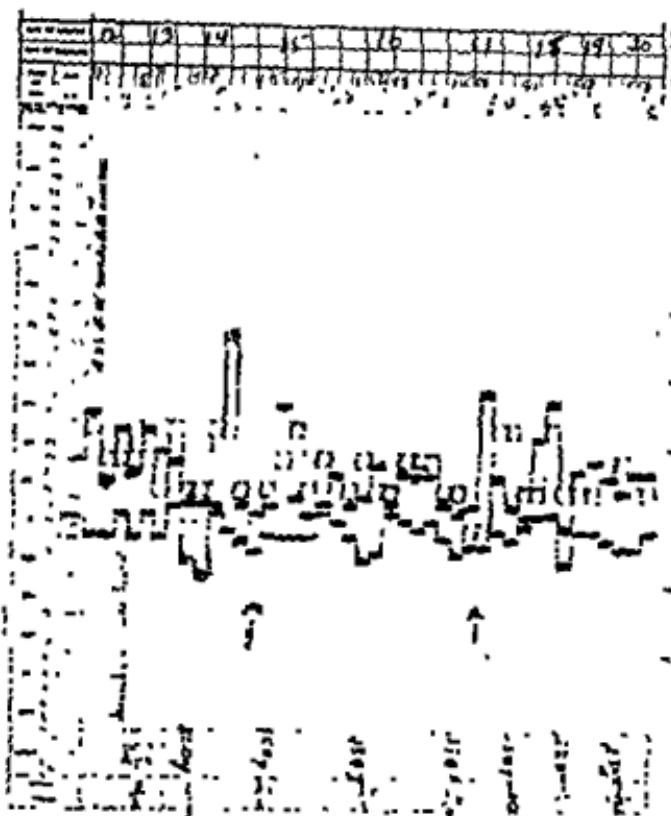


Fig. 78.—Chart from patient suffering from intermittent attacks of headache and medullary depression. Two of these attacks are shown on the chart. A more frequent record would have illustrated the duration of attacks as being several hours in length, the second attack lasting throughout the day.

attacks there was still present a normal outlet for the ventricular fluid.

#### CHRONIC INTERNAL HYDROCEPHALUS

This group of cases presents a pathetic and depressing picture to the physician as well as to the family. It occurs usually in children, and few cases survive to puberty, though occasionally one sees a case which has reached adult life through some spontaneous correction of the early condition. In the hydrocephalic child enormous dilatation of the ventricles may occur and the child present the familiar picture of great enlargement of the head with maintenance of normal features. Many attempts have been made to relieve this condition early

in order to prevent the almost inevitable outcome of such a condition. All these methods are directed toward establishing a new opening to allow the cerebrospinal fluid to reach the subarachnoid spaces and permit its normal absorption.

Several attempts have been made in this clinic by Dr. Grant and myself to accurately locate the floor of the third ventricle by use of a small cystoscope, and with the aid of the instrument tear a large enough opening to allow permanent drainage in this area. Colossal punctures have also been effective,



Fig. 76.—A ten month-old hydrocephalic baby with head measuring 64 cm. Following ventriculostomy with establishment of a ventricular fistula through the cortex the child has continued for a year without further enlargement.

but little success at maintaining a permanent fistula has been acquired. A case, reported by Dr. Frazier and Dr. deSchweinitz, where the patient was fed large doses of thyroid, seems to have produced a cure in this one instance, and this patient is still alive. As yet little of permanent value has been done along surgical lines, and further evidence is necessary before a definite means of treatment can be outlined.

**Cause**—This condition has been ascribed to several causes: trauma at birth in which there is probably hemorrhage about

the base or even a rupture of the tentorial membrane, with consequent hemorrhage around the posterior fossa. Meningitis, encephalitis, and mechanical obstructions such as tumors are the most frequent findings.

Certain it is that some obstructive processes occur in or about the entrance or exit of the aqueduct of Sylvius which may be partial or complete. Those cases of partial obstruction may have been complete in the early stages, and later some slight compensation has been acquired either in the form of drainage into the subarachnoid spaces or in partial suppression of choroidal function (Fig. 76).

#### COMPARATIVE VALUES OF SALT SOLUTIONS

In the treatment of increased intracranial pressure by means of dehydrating agents it is well to understand their characteristic actions.

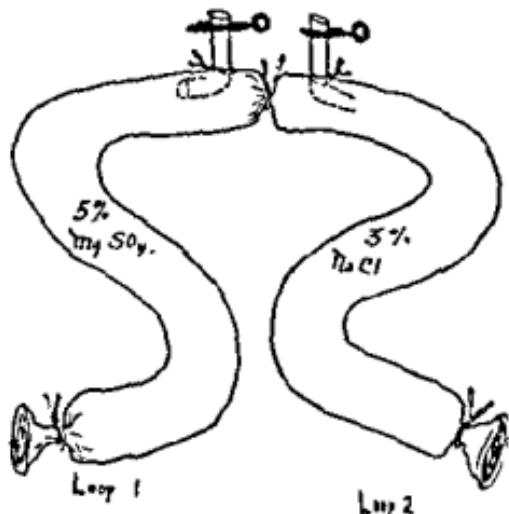


Fig. 77.—83 c.c. of isotonic solutions of each salt was placed in equal loops of gut. At the end of fifteen minutes the fluid from each loop was withdrawn, 155 c.c. was obtained from loop containing magnesium sulphate, and 120 c.c. was withdrawn from loop containing the sodium chlorid

It has been shown in the laboratory that the use of sodium chlorid and magnesium sulphate in dehydration of the brain have quite different properties when equal quantities of isotonic

solutions are introduced into equal loops of gut, and the cerebrospinal pressure observed carefully. Both solutions cause a fall in spinal pressure within a very few minutes, but, upon recovering the solutions from their respective isolated loops, almost twice as much fluid will be found to have been withdrawn from the animal's circulation in the case of magnesium

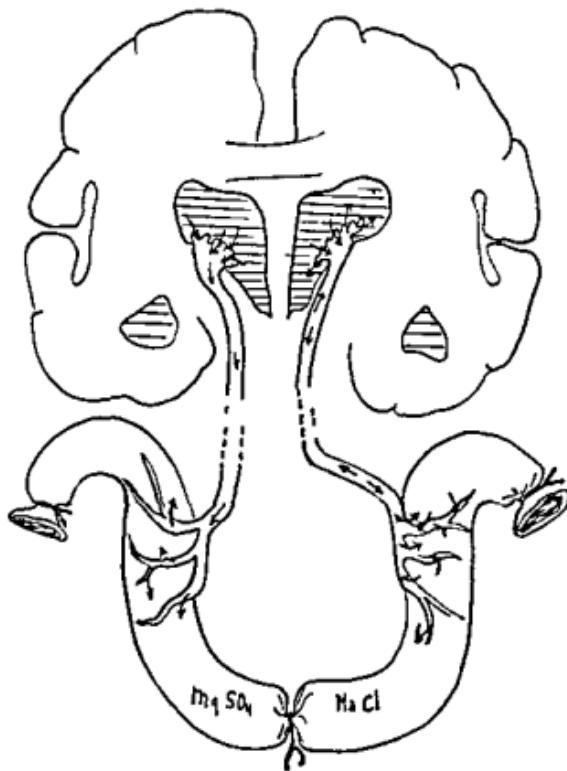


Fig. 78.—Diagram showing the probable action of the two salts. Sodium chloride is dializable and enters the circulation where its action is direct upon the ventricular fluids. Magnesium sulphate exerts its hydroscopic action entirely from within the intestinal tract.

sulphate as compared to that found withdrawn by the sodium chloride (Figs. 77, 78)

An explanation of this phenomenon lies not primarily with the salts themselves, but with the dializability of the sodium chloride which rapidly enters the circulation and thus reduces its concentration in the loop of gut. In entering the circulation

it withdraws fluid from the tissue spaces into the blood-vessels, which are now carrying a hypertonic, saline solution. At the same time there is a withdrawal of fluid from the vessels into the intestinal loops containing the sodium chlorid.

It will be seen that as soon as the salt diffuses into the tissues and becomes equal to the amount in the circulation and intestinal tract, then its hydroscopic value will cease, but, further than this, as soon as kidney elimination depletes the circulating salt from the vessels, there will be a reversal of fluid direction into the tissues, as they then become hypertonic to the blood-stream.

This, we feel, may be the cause for secondary waves of pressure seen clinically after the use of sodium chlorid.

Magnesium sulphate, on the other hand, being entirely confined to the intestinal tract and non-dializable, and not entering the circulation, withdraws fluid constantly from the vessels which, in turn, augment their volume from the tissue collections of fluid and ventricular system.

The accompanying charts will show diagrammatically the values and differential points of these two salts.

#### DISCUSSION OF SO-CALLED "MEDULLARY EDEMA"

The term "medullary edema" has often been used to designate a picture of compression arising about the brain stem and vital centers. Its explanation as a tissue edema has been much in doubt, since no pathologic evidence is available to show that in acute traumatic cases, where medullary symptoms become suddenly manifest, that an actual swelling, degeneration, or vacuolization has occurred in and about the cells. The term "edema" is, therefore, not well founded, and some other explanation must be given to account for the phenomena of slowing of the pulse and respiration, which is so frequently seen to occur. A theory which, though purely hypothetic, I feel can be advanced, and until further evidence has been presented will explain the occurrence of pressure symptoms about the floor of the fourth ventricle becoming manifest in the slow pulse and respiration seen early in these cases. It is well known

that irritation of the vagus center will cause reduction in the pulse rate. Stimulation of the posterior root of the fifth nerve, whose nucleus lies close to that of the tenth may also give a marked reduction in pulse rate due to reflex vagus depressor action, as frequently noted in avulsion of the posterior root of the fifth. The fall in respiratory rate is likewise caused by pressure on the floor of the fourth ventricle. McCleod points to the tip of the calamus scriptorum as being the site of origin of the respiratory stimulus. Its position lies in the midline on the floor of the fourth ventricle. The structures therefore, involved in this pressure syndrome are closely located with relation one to the other. It is natural to question why pressure at this point should manifest itself to a greater degree than perhaps at any other site in the cerebral system. The extreme sensitivity of these centers of vital functions must of course, be borne in mind.

It has been observed in cases of syringobulbia that a depression occurs over the area of the tenth nucleus, so that a section of the cord at this level shows an outpouring of the fourth ventricle into this region. The possibility of a structural defect in the fiber paths in this area may be offered as an explanation for the selection of this site in preference to an other, as manifested by syringobulbia. With this possibility in mind increase in intracranial tension might more easily exert its influence on the tenth nucleus as an irritant with vagus depression as gradual compression of the neurologic structures occur. That the condition is entirely due to pressure only, and not edema, seems evident for several reasons. An actual tissue edema of the medulla has never been demonstrated pathologically in cases of acute traumatic lesions. Tissue edemas, as we know them, are not rectified immediately upon relief of the obstructive cause, for active histologic changes are noted in cells and tissue structures which have undergone an edematous process.

In cases of acute "medullary edema," so called, relief of symptoms by ventricular tap has been almost immediate. Change of position in cases where medullary symptoms begin

to appear (the patient placed face downward, with elevation of the foot of the bed) will give almost immediate improvement of symptoms. Decompression of the foramen magnum and suboccipital region will frequently relieve such symptoms. Two cases may be cited which bear this point out in a striking manner:

**Case I.**—C. S., thirty-three years of age. Patient was operated on two years ago, a suboccipital craniectomy performed by



Fig. 79.—x-Ray plate of ventriculogram showing the huge dilatation of both ventricles.

Dr. Frazier, and disclosed a cerebellar glioma occupying the area between the two hemispheres. Removal was impossible due to the extent of the lesion, and active x-ray and radium

treatments brought a great measure of relief over one and a half years. The patient has returned to us showing advanced symptoms of posterior fossa pressure with loss of sight ataxia to the degree that he is unable to leave his bed and a large suboccipital hernia presenting itself, obstruction of the fourth ventricle causing huge dilatation of the ventricles with marked symptoms of intracranial pressure (Fig. 79). He was subject

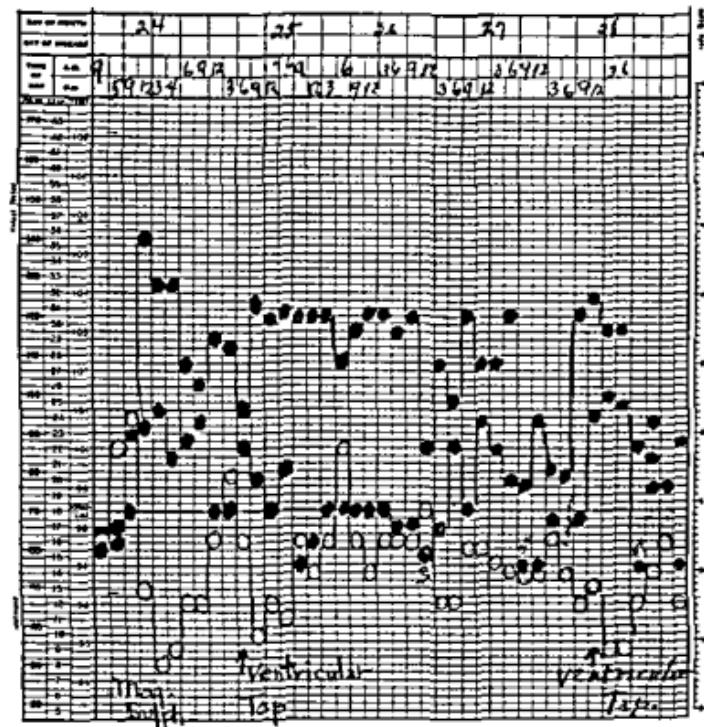


Fig 80.—Chart showing the relief from medullary depression caused by ventricular tap and magnesium sulphate. Circles indicate respiratory rate. Complete respiratory failure occurred twice in this case.

to attacks of so called "medullary edema" (Fig 80). The first of these attacks I saw him in occurred a few minutes before entering the ward, and I found the patient had ceased to breathe and was being given artificial respiration by Dr Leaman, the resident physician. A hurried examination revealed the heart to be still active and a lumbar puncture needle was plunged through an old trephine opening of the skull, directly into the

right ventricle; 6 ounces of fluid were withdrawn, the patient immediately began to breathe irregularly, and within an hour had regained complete consciousness. The second time, I received an urgent call two weeks later, stating a similar condition had occurred, and again, upon the withdrawal of a large amount of ventricular fluid, the patient was revived and returned to consciousness. This method of relieving pressure was repeated on several occasions by the resident to meet these emergencies, but the final outcome was inevitable, although we were able to prolong the patient's life for a period of six weeks.

**Case II.**—A second case, of a young girl (A. G., eighteen years of age), suffering from a similar lesion of the cerebellum with ventricular obstruction.

The operative notes, by Dr. Frazier, give the salient features of an interesting phase of this case: "Shortly after the patient had received a hypodermic of morphin, while she was being shaved, she could not be aroused. Temperature 96° F., pulse 120. A consultation was held, and it was decided, under the circumstances, to do a subtemporal decompression. While preparation was being made for that there was a sudden attack of respiratory failure. The patient became deeply cyanosed and stopped breathing. Artificial respiration was begun, endopharyngeal insufflation, and preparation made for a suboccipital decompression. An attempt was made first to evacuate the left ventricle, which failed, but was successful on the right ventricle. Fluid spurted out almost into the face of the operator so great was the tension. Then a vertical incision under the midline over the occipital protuberance down to the bone was exposed, and a small area on either side of the midline removed, including the posterior rim of the foramen magnum and the laminæ of the axis. The occipital sinus was ligated between two ligatures and dural incision carried out 2 cm. on each side of the median line and down beyond the level of the foramen magnum over the medulla. Hemorrhage from the margins in the dura about the foramen magnum was controlled with silver

dips. The whole operation was conducted without a general anesthetic, and just as the wound was about to be closed the patient had recovered consciousness enough to be disturbed by the introduction of the sutures. The pulse, respiration, and blood-pressure were satisfactory throughout."

A later operation revealed a large gliomatous cyst in the midline, which was evacuated, and the patient subsequently discharged in excellent condition.

These 2 cases, I feel, serve to illustrate the point that immediate removal of pressure brought about direct return of func-

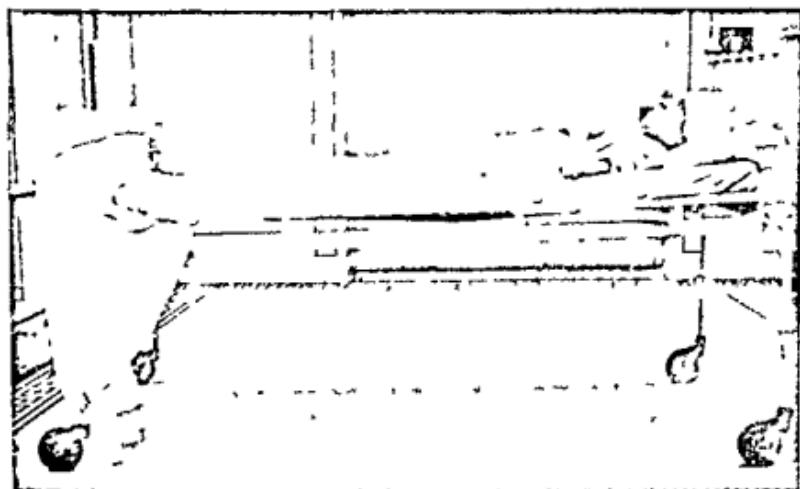


Fig. 81.—Position of patient with posterior fossa and fourth ventricle at the most dependent point of the ventricular system.

tion of the medullary centers involved. If an actual edema had been present the results would not have been so immediate.

Let us consider the interesting phenomena noted in postural conditions in the patient, so as to understand why this method of treatment has been accepted as one which will assist in the relief of medullary symptoms.

If the patient be placed upon the back, with the head upon a pillow, it will be noted that the position of the ventricles and spinal column is such that the anterior horn is at least 8 to 10 cm. above the posterior fossa (Fig. 81). It is a well-known law of hydrostatics that the pressure of a column of fluid is

exerted equally in all directions and, further, that pressure is transmitted through a fluid equally to all points of the fluid system. Hence, if we have an increase in intracranial tension, that pressure is manifest at every point in the cerebrospinal system in an equal degree, but, if we have added to the increase in intracranial tension the weight of a column of fluid 10 cm. in height, it will become manifest that at the base and in the region of the fourth ventricle, as well as along the spinal column, the pressure will be greater than in the anterior horn of the ventricle, so that in the change of position of the patient on to

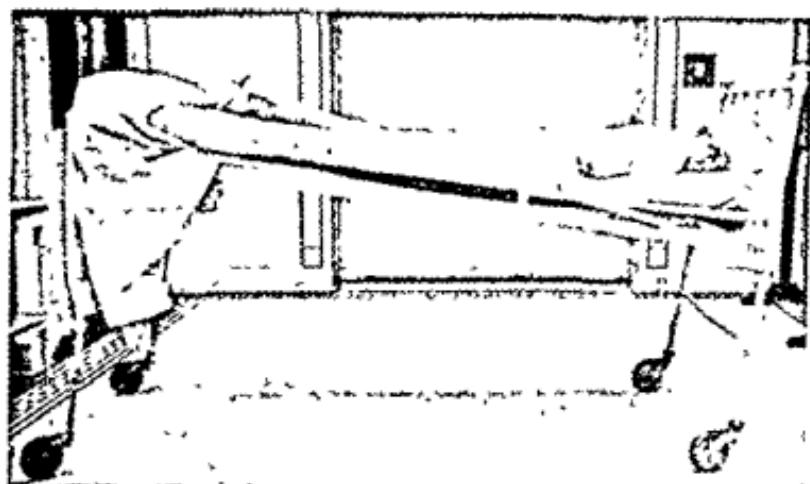


Fig. 82.—Showing elevation of the foot of the bed and reversal of the relations of the ventricular system. In this position the fourth ventricle is uppermost and free from the pressure of the column of fluid represented by the distance from the anterior horn of the lateral ventricle to the base.

the face and the elevation of the feet we produce a condition of the cerebrospinal fluid system which makes the fluid level of the cord and posterior fossa on the same plane, and inverting of the weight of the column of fluid represented by the distance between the fourth ventricle and the anterior horns, so that at least the added pressure is at once relieved (Fig. 82). An improvement in symptoms will bear this phenomenon out from clinical observations, and if the increase of cerebrospinal pressure can be arrested, the patient's condition will improve. It, therefore, seems evident that we are dealing with mechanical forces

which manifest themselves through direct pressure on the floor of the fourth ventricle and produce the so-called picture of "medullary edema," which may not be an edema at all but purely a pressure phenomena.

We have made no attempt to explain the respiratory behavior in cases of intracranial tension. It seems probable from the evidence brought forward by McCleod on respiratory functions that there is a decided vascular element which may play a part in the reduction of the respiratory rate. Since the actual theories as to the origin of respiratory impulses have not been established, it would be difficult to attempt any explanation of derangement of function of a part not yet thoroughly understood; however, evidence seems to point toward the control of respiratory function as dependent upon hydrogen ion concentration in the region of the calamus scriptorum. Certain experiments which he has cited seem to bear this out very strongly. This, however, does not entirely explain respiratory center reactions for the supply of oxygen to the center also has a direct effect upon its function. It may be possible that pressure exerted upon this area so constricts the vascular supply that biochemical reactions are interfered with to a degree which manifests itself in decrease of respiratory activity. A similar condition is noted when oxygen depletion occurs under certain cases of anesthesia and drowning where respiratory functions have ceased but cardiac action remains, and the patient upon proper administration of oxygen and stimulation may be again induced to breathe.

The theory, therefore, which we wish to present is one of pressure phenomenon manifesting itself more acutely in the region of the fourth ventricle where, perhaps the structural development is the weakest and pressure manifestations may become more evident. It may be of interest to know in passing that the calamus scriptorum, or the "writer's pen" is a small stiletto-like elevation of the floor of the fourth ventricle, and, if this be the center for respiratory stimulus, it is evident that it lies exposed on three sides to the direct influence of pressure exerted about it in the floor of the fourth ventricle, hence vascular constriction by pressure might be more easily accomplished.



## CLINIC OF DRs JOHN SPEESE AND THOMAS KLEIN

PRESBYTERIAN HOSPITAL

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### THE USE OF ILETIN IN THE POSTOPERATIVE TREATMENT OF ACUTE HEMORRHAGIC PANCREATITIS

THE literature, to the best of our knowledge does not contain any record of the use of iletin in the postoperative treatment of acute hemorrhagic pancreatitis. Fully realizing that it is too early (two months after operation) to formulate an idea of the ultimate outcome of the case, but owing to the patient's recovery and the marked improvement clinically from the time iletin was administered, it appears to be worthy of record. At the same time we fully appreciate that a certain percentage of these cases recovered before iletin was discovered. Bearing in mind, however, the increasing mortality in the late operative cases (this case was not operated upon until the late third or early fourth day) and in addition to the grave clinical outlook the day following the operation, it seems to us that iletin played a definite and useful rôle. In the report of this case we hope to stimulate further work upon this line.

The history of the case is as follows. Mrs A B, aged fifty one, white, was admitted to the hospital November 10, 1923, complaining of persistent vomiting, pain, and soreness in the upper abdomen. The pain was first noticed November 8, 1923, has been paroxysmal, located in the upper right quadrant of the abdomen, and has radiated to the right shoulder. Vomiting started shortly after the pain began and has continued for three days, and has followed the ingestion of all food or liquids. Bowels have not moved for two days, the patient, however, has suffered from chronic constipation. She has had more or less pain and distress after meals for years, but has never been jaundiced. She has had other similar attacks but none so severe

as the present one. The urine has been examined several times previously and did not contain sugar.

The abdomen was large, slightly pendulous, and moderately distended. There was rigidity and tenderness across the entire upper abdomen, but more marked on the right side, beneath the costal margin; the gall-bladder was not palpable. Temperature 100.4° F., pulse 120, respiration 28, white blood-corpuscles 20,000.

The patient, while acutely ill, did not appear greatly shocked. A diagnosis of acute cholecystitis was made and operation performed November 11, 1923, under gas-oxygen-ether anesthesia. On opening the abdomen a quantity of thin bloody serum escaped, and larger amounts were found in the right kidney pouch. Numerous areas of fat necrosis were scattered throughout the omentum and mesentery. The gall-bladder was distended and contained numerous calculi. The head of the pancreas appeared slightly enlarged and soft. The gall-bladder was opened, many calculi and thick tarry bile removed, and the organ drained. The bloody fluid was removed from the abdomen and the pancreas drained by a tube through the gastrohepatic omentum and a cigarette drain placed below the tube draining the gall-bladder.

The patient stood the operation well, and left the operating-room in good condition. On the following day there was considerable bloody drainage from the abdomen, and a moderate amount of bile drained from the tube. Biliary drainage was maintained for two weeks, when the tube came out, the fistula closed completely four weeks after the operation.

The day following the operation the patient was in poor condition. The temperature had gone up to 101.2° F., the pulse 136 per minute and of poor volume. She was quite shocked and the vomiting persisted. The vomitus consisted of a very dark bile-stained material, necessitating washing the stomach. The respiration varied between 28 and 36 per minute. The skin was cyanotic and moist. The abdominal condition was fairly good. The pain had entirely disappeared and peristalsis was active; she was able to expel flatus. It was at this time that we found

the blood sugar 0.238 gm and the plasma carbon dioxide down to 49 volume per cent. Saline enteroclysis had been started immediately after the operation, so that the patient was in no way dehydrated, even though vomiting.

After the gastric lavage the iletin was given—10 units of the U variety being given hypodermically every eight hours. Shortly after the first dose the stomach quieted itself and the patient was able to retain 50 gm of oatmeal. Within the next twenty four hours she was able to retain orange albumen and 20 gm of dry toast. In all, during that period, she retained approximately 69 gm of carbohydrate, 24 gm of protein, and 2.5 gm of fat. The improvement which followed was remarkable, the temperature the next morning had dropped to 99° F, the pulse was 100 and of much better volume, the respiratory rate, however, remained 28. The mental stupor, which had been quite pronounced the day previous had entirely cleared, she became apprehensive and interested in things about her. The blood sugar had fallen to 0.145 gm and the plasma CO<sub>2</sub> had risen to normal—61 volume per cent. The urine did not show any sugar, acetone, or diacetic acid. The diet and iletin were allowed to remain the same. The patient complained of a marked distaste for food and some substernal discomfort. At all times water was forced by mouth and the enteroclysis continued. The urinary output had increased to 1200 c.c. for the twenty four hour period. Each day the clinical improvement continued, the temperature, pulse, and respiration gradually reaching the normal. The iletin was gradually diminished and the food intake increased. The fats were purposely kept low on account of the patient being overweight at the beginning. The acidosis had entirely disappeared and there were no other indications for the low fat feeding. Upon the sixth day when the patient was receiving a diet of 736 calories (fat 33.5 gm., protein 38.3 gm., carbohydrate 72.8 gm.) and 15 units of iletin (5 units every eight hours before feedings), she had a rather severe hypoglycemic reaction. The blood sugar at this time had dropped to 0.075 gm. The iletin was stopped entirely, and for the ensuing six days she remained entirely sugar free.

| Date     | Diet.               |         |             | Iletin, | Blood. | Urine          |                       |   | Diacetic,<br>acetone |
|----------|---------------------|---------|-------------|---------|--------|----------------|-----------------------|---|----------------------|
|          | Calories,<br>total. | Fat, gm | Protein, gm |         |        | Units per day. | Sugar per 100<br>c.c. | Plasma CO <sub>2</sub><br>vol. per cent |                      |
| 11/11/23 | Oper-<br>ation.     |         |             |         |        |                |                       |   |                      |
| 11/12/23 | 402                 | 2 4     | 24 9        | 60 6    | 30     | 238            | 49                    |   |                      |
| 11/14/23 | 402                 | 2 4     | 24 9        | 60 6    | 30     | 145            | 61                    | 1200                                    | 0 0                  |
| 11/15/23 | 402                 | 2 4     | 24 9        | 69 6    | 21     | 133            | 60                    | 1000                                    | 0 0                  |
| 11/16/23 | 548                 | 17 3    | 25 3        | 72 8    | 27     | 154            | 57                    |   |                      |
| 11/17/23 | 736                 | 33 5    | 38 3        | 72 8    | 15     | 75             | 65                    | 700                                     | 0 0                  |
| 11/18/23 | 736                 | 33 5    | 38 3        | 72 8    | 0      |                |                       | 930                                     | 0 0                  |
| 11/19/23 | 1120                | 49 1    | 52 4        | 118     | 0      | 114            | 52                    | 600                                     | 0 0 0 0              |
| 11/20/23 | 1120                | 49 1    | 52 4        | 118     | 0      | 118            | 63                    | 1200                                    | 0 0 0 0              |
| 11/21/23 | 1120                | 49 1    | 52 4        | 118     | 0      | 94             | 52                    |   |                      |
| 11/23/23 | 1515                | 57 7    | 67 8        | 151     | 0      | 97             | 50                    | 1000                                    | 0 0 0 0              |
| 11/24/23 | 1555                | 65 5    | 86          | 156 8   | 0      |                |                       | 1400                                    | 0 0 0 0              |
| 11/26/23 | 1407                | 68 6    | 73          | 140     | 15     | 94             | 58                    | 1300                                    | 0 0 0 0              |
| 11/28/23 | 1694                | 86 8    | 81          | 146 9   | 15     | 121            | 50                    | 1500                                    | 0 0 0 0              |
| 11/30/23 | 1684                | 86 8    | 81          | 146 9   | 15     | 114            | 55                    | 400                                     | 0 0 0 0              |
| 12/ 3/23 | 1401                | 72 6    | 73 2        | 115 4   | 15     | 100            |                       | 1750                                    | 0 0 0 0              |
| 12/ 5/23 | 1802                | 96.7    | 90          | 144     | 15     | 108            |                       | 1200                                    | 0 0 0 0              |
| 12/ 6/23 | 1709                | 86      | 83          | 151     | 15     | 114            |                       | 1225                                    | 0 0 0 0              |
| 12/10/23 | 1591                | 76      | 86          | 141     | 10     | 71             |                       | 1000                                    | 0 0 0 0              |
| 12/14/23 | 1606                | 78 5    | 81          | 144     | 10     | 105            |                       | 1300                                    | 0 0 0 0              |
| 12/17/23 | 1688                | 89 8    | 76          | 144     | 5      | 100            |                       | 800                                     | 0 0 0 0              |
| 12/24/23 | 1768                | 100 6   | 71          | 145     | 5      | 105            |                       | 1250                                    | 0 0 0 0              |

The diet was gradually increased until at the end of this time, twelve days after the operation, she was taking 1555 calories (fat 65.5 gm., protein 67 gm., carbohydrate 156.8 gm.). In the meantime, as is seen from the accompanying chart, the blood-sugar remained entirely within normal limits. Upon the following day, when we omitted the blood-sugar estimation, she showed, for the first and only time, 0.3 per cent. of sugar in the urine. The carbohydrate content was slightly reduced to 140 gm and the iletin restarted (5 units three times a day). The blood-sugar the following day was again 0.094 gm. and the plasma CO<sub>2</sub>, 58 volume per cent.

From this time on the carbohydrates were allowed to remain practically fixed, the increased caloric intake being made up of additional fats, but was allowed to remain much lower than the rather high carbohydrate content. The proteins unfortunately, though they caused no apparent harm, were high, this being explained by the patient's marked desire for orange-albumen.

At the end of the fourth week the iletin was reduced to 10 units per day. Everything continued nicely, the patient's wound had entirely healed and she was out of bed. The blood sugar remained well within normal limits, the urinary output good and entirely free from sugar, acetone, and diacetic acid. Being extremely anxious to free her from the use of iletin if possible, the dose was reduced to 5 units per day. In the course of a few days it was entirely stopped and the patient still continued to be sugar free. Upon December 29th (forty eight days after operation) she was discharged from the hospital apparently well, without using iletin. At that time blood sugar was 0.100 gm, the diet 1768 calories, and consisted of fat 100 gm, protein 71, and carbohydrate 145 gm.

Since leaving the hospital the patient has been able to return to her work as assistant housekeeper and has not at any time shown any sugar in the urine. We realize that only two months have passed since the operation and, like many others, she may at a later date develop a true diabetes. On the contrary, as stated above, it appears in this particular case iletin did help tide us over a very serious and critical period. Without a doubt it was of great help in re establishing this patient's carbohydrate tolerance. With this in view and in hoping to stimulate further work in this field we present the case.



## ACUTE MESENTERIC LYMPHADENITIS ASSOCIATED WITH CHRONIC APPENDICITIS

THE patient, a boy two years of age, was admitted to the Presbyterian Hospital October 10 1923 with the following history. For the past months he has had numerous attacks of abdominal pain, loss of appetite, and lacked his usual energy. During this time he was not seen by a physician until three days before admission when he became acutely ill. At this time the child had fever ( $102^{\circ}$  F), generalized but spasmodic abdominal pain, and was tender over the right lower quadrant of the abdomen. The bowels moved daily, there was no vomiting. There was no change in the above symptoms for the following two days. The pain and tenderness persisting a tentative diagnosis of appendicitis was made and the child sent to the hospital. On admission the temperature was  $102.3^{\circ}$  F, pulse 120, respiration 32, urine negative. White blood cells 22,250, of which 80 per cent were polymorphonuclear.

A diagnosis of acute appendicitis was made and the abdomen opened under ether anesthesia. The appendix was found completely covered with fine adhesions and adherent throughout its length (8 cm) to the posterior and outer surface of the cecum, from which it was removed. In the mesentery of the terminal ileum numerous enlarged lymph nodes were found. These varied in size, the largest being the size of a cherry, were tense, mottled with red, soft in consistency, the peritoneal covering being smooth and showed no signs of adhesions or tubercles. The condition was regarded as an acute adenitis, non tuberculous, and probably secondary to the inflammation of the appendix. There was no free fluid in the abdomen or other demonstrable pathologic conditions.

The abdomen was closed, the patient made an uninterrupted recovery. The temperature persisted for the next two weeks  $102^{\circ}$  to  $101^{\circ}$  F, gradually falling to normal. Examination of

the stools for tubercle bacilli was negative, von Pirquet reaction negative, white blood-cells 10,500 four days after operation.

**Pathologic Examination of Appendix.**--On examining the appendix the walls seem somewhat thicker than normal. The microscopic examination shows evidence of chronic inflammation in the muscular coats, and acute inflammation in the mucosa.

Freeman has recently (*Surg., Gyn., and Obs.*, 1923, 37, 149) called attention to the surgical significance of mesenteric lymphadenitis. As little attention has been directed to this condition, either in current literature or in text-books, I am indebted to the above-mentioned writer for a description of the symptoms.

There is abdominal pain, usually somewhat diffuse, but with a predilection for the right lower quadrant, due, perhaps, to the fact that the attachment of the affected mesentery runs obliquely in that direction. It usually is not severe and often quite difficult to locate with exactness.

Distinct abdominal colics frequently occur; these come and go quickly, without apparent cause, and probably are produced by spasm of the bowel.

The colics may be regarded as a valuable diagnostic symptom, and when they are present they should lead one to suspect mesenteric lymphadenitis.

Abdominal tenderness is always present, but it is more diffuse and not so pronounced as is usual in appendicitis. Its general location is toward the right lower quadrant, for the same reason that this is the principal seat of pain.

Abdominal rigidity is not a prominent feature unless there is a coincident appendicitis. Like pain and tenderness, it is more or less diffuse, but with a tendency toward the right side.

A moderate elevation of temperature is often observed. It seldom goes higher than 99° to 100° F., and is not accompanied by chills. It may persist for weeks or months.

Loss of energy and flesh are quite constant, and occasionally there are severe, prolonged headaches, perhaps due to some form of toxemia.

Various gastro-intestinal disturbances are common, such as

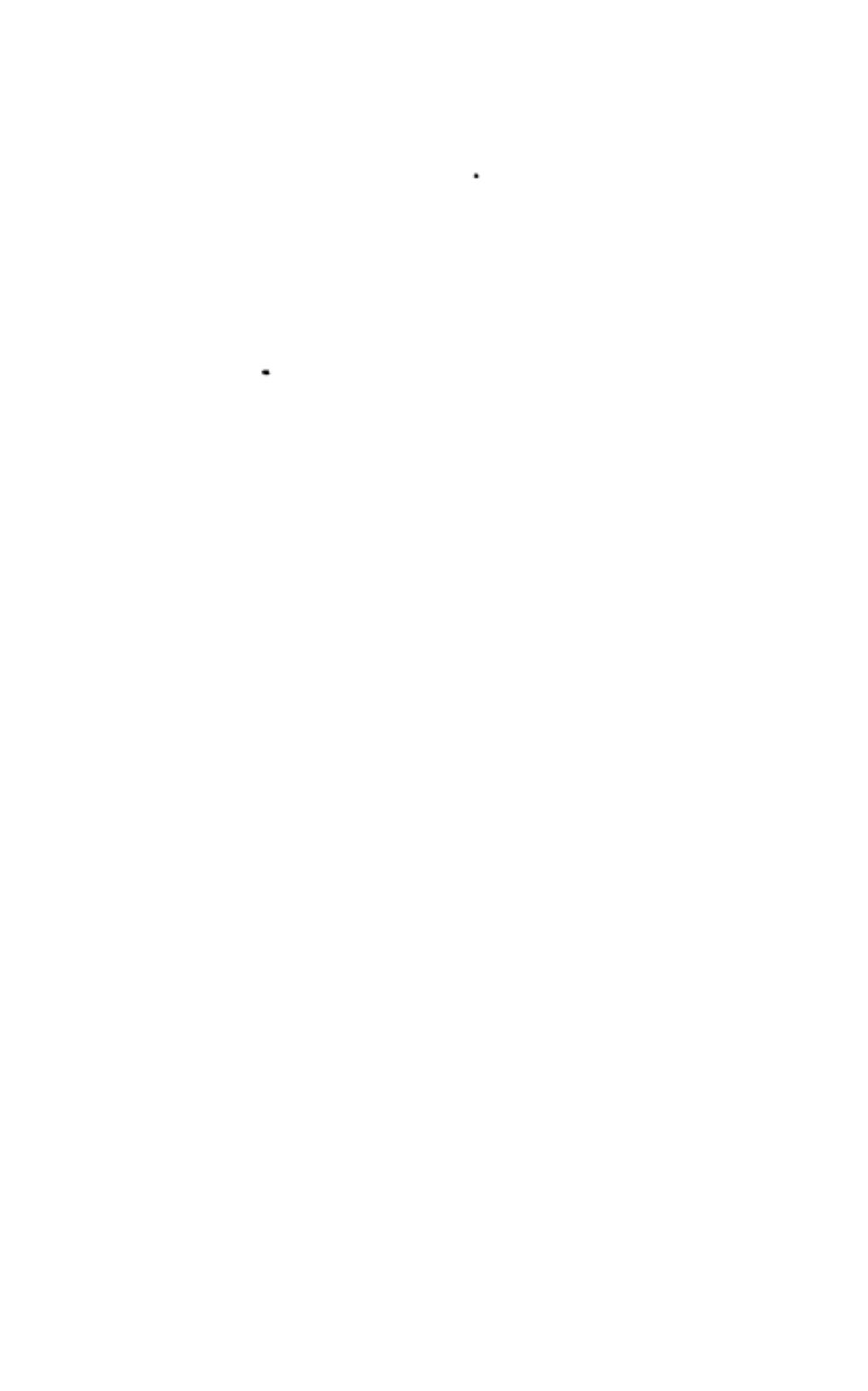
loss of appetite, nausea, pyloric spasm, flatulence, constipation, and occasionally diarrhea.

In the majority of the recorded cases the affection is chronic, although in a few instances a more acute course is followed. In such cases the diagnosis from appendicitis is impossible, but in the chronic forms Freeman believes that mesenteric lymphadenitis should be suspected when a child is encountered with indefinite abdominal pain, tenderness, and rigidity, manifesting themselves mostly in the right lower quadrant, with digestive symptoms, loss of energy, and moderate fever, especially if the symptoms persist for several weeks or months and are accompanied by frequent intestinal colics.

The disease may represent the first stage of the ordinary *tabes mesentericus*, and in many cases the nodes removed at operation have shown the evidence of tuberculosis. It must be assumed, however, that the disease under discussion is usually self-limited and seldom develops into a true tuberculous adenitis.

It is believed that the infective agent, whether the tubercle bacilli or other organism, gains access to the nodes through the mucosa of the intestine, following the ingestion of contaminated food. It is interesting to note that the presence of tuberculosis elsewhere has not been demonstrated in the cases reported by Struthers and Freeman. This is true in my case, in which a most careful examination and the subsequent history of the case has failed to show any symptoms of tuberculosis.

As most of the cases are diagnosed at operation, the measures used in treatment are medical and hygienic. Most of the cases improve after laparotomy in the same manner that tuberculous peritonitis is benefited by simply opening the abdomen. It is not unlikely that the removal of a chronically diseased appendix, by excluding an additional source of infection, may have a decidedly beneficial action.



## CLINIC OF DR. LEON HERMAN

### PENNSYLVANIA HOSPITAL

#### RENAL ANOMALOGY

We have several patients with renal anomalies which we will use as a text for our discussion. Congenital anomalies of the upper urinary organs are not at all uncommon, and are frequently discovered accidentally during the course of routine urologic examinations. They often give rise to no clinical symp-



Fig. 83.—Pyonephrosis in the lower half of a double left kidney. Note the small size of the upper pelvis.

toms. In a proportion of cases the patients complain of symptoms in the absence of demonstrable complicating factors. Thus, in 29 of a series of 144 patients with congenital defects of the upper urinary tract observed at the Mayo Clinic, no evidence of disease could be found to explain the pain suggestive

of renal colic, often associated with chills and fever, of which these individuals complained. Congenital malposition of the kidneys is especially likely to cause pain in the absence of complications, so that the history of persistent pain in the back without obvious cause calls for the most careful cystoscopic and pyelographic studies.

The first case which we have to present is illustrative of the fact that the normally situated but congenitally abnormal upper urinary structures may give rise to no clinical symptoms for many years, or until the onset of a complicating infection. This patient, a woman of seventy years, was entirely well until the onset of a colon bacillus infection of the lower half of a double kidney (Fig. 83). Throughout the course of her illness the clinical picture was referable to infection alone, and was in no wise modified as a result of the congenital anomaly.

**Case I. Bilateral Duplication of Ureter and Renal Pelvis (Duplex Kidney) With Hemipyonephrosis.**<sup>1</sup>—Mary P., aged seventy years, was admitted to the Methodist Hospital of Philadelphia in September, 1920, with symptoms suggestive of acute gastro-enteritis. The condition was so diagnosed by the internists, and after ten days' residence in the wards she had recovered sufficiently to resume her work as a cook. This attack of fever, abdominal pain, diarrhea, and vomiting was, in all probability, due to renal infection, the absence of pyuria at this time being attributable to temporary closure of the ureter. She remained well during the ensuing seven months with the exception of urinary frequency, but found it necessary to re-enter the hospital on May 21, 1921, when the following notes were made by Dr. Reiff and his staff:

*Chief Complaint.*—Pain in the left side and epigastrium; vomiting.

*Present Illness.*—For the past six weeks has been feeling ill. The trouble began with pain in the left side of the abdomen and in the left loin. The pain is deep seated and comes in definite attacks with, but not relieved by, vomiting. The pain begins

<sup>1</sup> Brief report of this case made before the Philadelphia Academy of Surgery, December, 1923.

in the left side and spreads to the abdomen and back "The pain in the left side is the first to come and the last to go" There is no radiation of the pain downward Chills accompany the attacks of pain With the exception of nocturia (four) there are no bladder symptoms She has never been jaundiced The bowels move daily and there is some relief of pain after defecation The patient states that the initial attack of pain was in September, 1920 (the time of her first admission), and since that time there has been excessive thirst, the daily intake of water being from 3 to 5 quarts, with failure to relieve the intense thirst

*Physical Examination*—The patient is an emaciated, flabby, senile woman (One year ago she weighed 195 pounds, present weight 158 pounds) Examination of the head, neck, and chest showed nothing abnormal, with the exception of chronic myocarditis The abdomen was found to be pendulous, but no masses were palpable There was slight tenderness in the epigastrium and definite tenderness in the left lumbar area Deep pressure elicited no tenderness in the left costovertebral angle The extremities were negative, with only moderate sclerosis of the peripheral vessels

*Pelvic Examination*—"Cystocele and rectocele Some tenderness in the vaginal vault, but no induration of the broad ligaments The uterus is infantile and slightly retrodisplaced"

The urine on admission showed the presence of pus and sugar

The x ray examination was negative except for the presence of a moderately dilated stomach and marked osteoarthritic changes in the second and third lumbar vertebrae On May 26 1921 the blood sugar was 0.263 the blood urea 14 mg, Blood Wassermann negative, hemoglobin 85 per cent, red blood corpuscles, 4,790,000, white blood corpuscles, 21,600

*Cystoscopic Examination* (June 6, 1921, Dr Herman)—"The bladder urine contains many heavy flakes of mucopus The bladder mucosa is slightly reddened in the basal area, and there is seen lying on the floor of the bladder a number of worm like masses, white in color, and apparently made up of pus The

bladder is very tolerant and of large capacity. On the left side there are two ureteral orifices situated  $\frac{1}{2}$  inch apart. A single ureteral orifice is seen on the right side. When pressure is made

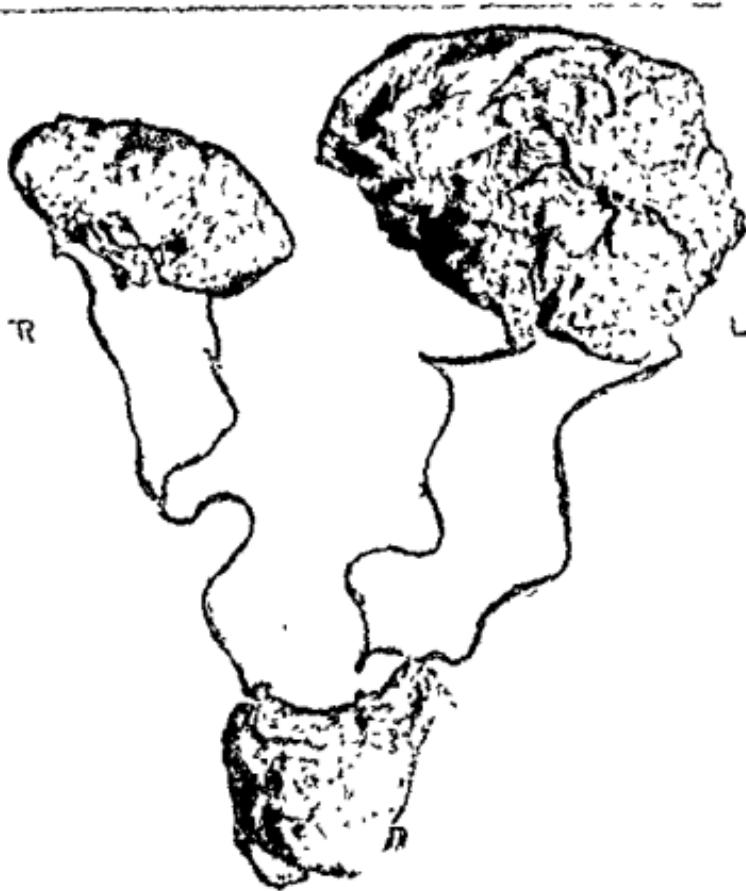


Fig. 84.—Postmortem specimen of bilateral bifurcation of the ureter, the right side being incomplete. There is a large pyonephrotic sac on the left side affecting the lower half of the duplex pelvis. The photograph is taken with the kidneys rotated, but it will be observed that the upper kidney on the left side (innermost ureter) is relatively normal and surrounded by the pyonephrotic lower half. A portion of the diaphragm is adherent to the sac.

over the left renal area, a pus cast is made to protrude from the left posterior urethral orifice. This cast is identical with those noted in the bladder. Ureteral catheters, size No. 6 F., passed to the pelvis of the right kidney and to the pelvis on the left

side, there is no demonstrable shortening of either ureter. Comparatively clear urine is obtained from the right kidney and from the upper segment of the left kidney, heavy purulent material is obtained from the lower left renal segment (posterior ureteral opening) after injecting water, the undiluted pus being too thick to pass through the catheter. Phthalein (1 c.c. intravenously) appears from the right kidney and from the upper left kidney in eleven minutes, the lower left segment does not function. The quantitative estimation shows an output of 5 per cent from the right kidney and less than 5 per cent from the upper left kidney in a fifteen minute period. The pyelogram (sodium iodid, 15 per cent) shows the relatively normal upper segment and the pyonephritic lower segment of the left kidney (Fig. 83).

The urines obtained by ureteral catheter showed the following:

| RIGHT KIDNEY        | UPPER LEFT            | LOWER LEFT            |
|---------------------|-----------------------|-----------------------|
| Color—amber         | Color—amber           | Color—milky white     |
| Slightly turbid     | Slightly turbid       | Thick                 |
| Reaction acid       | Reaction acid         | Reaction alkaline     |
| Sugar negative      | Sugar negative        | Sugar negative        |
| Albumin faint trace | Albumin faint trace   | Albumin—heavy cloud   |
| <i>Microscopy</i>   |                       |                       |
| Epithelia—plus plus | R B C—some            | Pus laden             |
| R B C—some          | Leukocytes—some       | Culture—Bacillus coli |
| Leukocytes—plus     | Culture—Bacillus coli | Tb negative           |
| Culture—sterile     | Tb negative           |                       |
| Tb negative         |                       |                       |

An indwelling ureteral catheter was placed in the infected lower left segment and pelvic lavage done twice daily for several days. The diagnosis of congenital anomaly of the left kidney was made (duplication of the ureter and ureteral pelvis) with hemipyonephrosis involving the lower segment.

After drainage of the infected sac the pain ceased, the fever subsided quickly, the pyuria practically disappeared, and the patient's general condition improved markedly. The total renal function to phthalein at the last examination was 34 per

cent. for a two-hour period. Dr Reiff was able to restore the blood-sugar to the normal level by means of dietary regulation alone.

*Comments.*—This estimate of the total renal function was made after the cystoscopic studies and at a time when the patient's general condition was much improved; nevertheless, the results of the test together with the knowledge that we had a duplicated pelvis on the left side should have suggested to us the possibility of a duplication of the upper ureter and pelvis on the right side. Undoubtedly the small output of phthalein from the right kidney was due to the fact that our catheter had passed up one limb of a bifurcated ureter (Fig. 84), and we were merely draining one-half of the right kidney. The presence of a very small pyelographic shadow is suggestive of duplication, and in the making of pyelograms many congenital anomalies of the pelvis and upper ureter will be disclosed by following the suggestion of Braasch, and withdrawing the catheter slowly while the injection medium is flowing, and to take the roentgenogram when the catheter has been withdrawn to the level of the pelvic segment of the ureter. Very perfect ureteropyelograms may be procured with the use of the operating cystoscope and a large Garceau catheter, the latter being employed to block the lower ureter, which prevents the injection medium from flowing backward alongside of the catheter into the bladder.

*History Continued.*—After several weeks of treatment, with lavage of the infected pelvis, the patient returned to her work and remained well until January, 1923, when an exacerbation of the infection compelled her to re-enter the wards.

This attack was a mild one and responded to a single pelvic lavage. Disregarding our advice, the patient did not return for treatment, and a period of ten months of freedom from pain followed and she was apparently well until Saturday, October 27, 1923, when the present, and what has now proved to be fatal, attack began.

*Present Attack.*—On October 27, 1923 an attack similar to but more severe than the foregoing ones came on very abruptly.

During the past few days there has been puffiness of the lower eyelids and some swelling of the face. The output of urine has been scanty and during the week prior to admission the urine has been milky in appearance. There has been considerable irritability of the bladder and the bowels have been costive. This attack is much more severe than any of the preceding ones.



Fig. 85.—Skiagram of duplex kidney with pyonephrosis of the lower half. (See Figs. 83, 84.) The pus had extended beyond the sac and had invaded the left pleural space and the sheath of the left psoas muscle. The dense shadow underlying the twelfth rib was thought to be a calculus, but at postmortem it was found to be a collection of gritty inspissated pus. (Skiagram by Dr. Bowen.)

and is associated with marked toxemia, remittant fever; leukocytes 17,000. The important findings at the time of the initial physical examination were recorded as follows:

*Physical Examination.*—Patient is very toxic, eyelids swollen; there is some impairment of resonance in the left lower base with râles, but the breathing is vesicular in type throughout. The heart is somewhat enlarged and the sounds distinct. Systolic

pressure, 145; diastolic, 70. There are no masses palpable in the abdomen and no muscle rigidity, but the patient complains of great tenderness when pressure is made over the left kidney anteriorly. Urine contains small amount of sugar, a few casts, and much pus.

x-Ray examination (November 5, 1923) (Fig. 85): "There is a large irregular shadow approximately 8 by 4 cm. which apparently lies in the lower pole of a very much enlarged left kidney. There are certain irregular shadows in the pelvis, one of which possibly represents a large calculus, 1 by  $2\frac{1}{2}$  cm., near the distal end of the right ureter."

*Comments*—In contrasting the foregoing findings with those recorded at the Methodist Hospital in 1920 we would be justified in concluding that the patient was having a more severe but similar acute exacerbation of the left-sided renal infection; that there is, in addition, a beginning pulmonary complication, and also very definite evidence of renal failure. You will note especially that there was no rigidity of the abdominal muscles, nor could a mass be felt in the renal area at this time.

*History Continued*.—On 11/2/23 the impaired resonance over the left lung had extended to the level of the angle of the scapula, the patient has bronchovesicular breathing with subcrepitant râles or a faint friction sound over this area.

On 11/5/23 Dr George Norris was able to outline a small smooth rounded mass in the region of the left kidney, this, as we have already remarked, was confirmed by a roentgenogram taken on the same day (Fig. 85).

The total renal function to phthalein was 30 per cent. Blood chemistry non-protein nitrogen, 33.1, urea nitrogen, 12.5, blood-sugar, 0.227.

*Cystoscopy* (11/8/23)—Clear urine from upper kidney (left); great quantities of pus-laden urine from lower kidney (left). Pelvis irrigated.

*History Continued*—This lavage was followed by some relief from pain, and there was a certain amount of general improvement, notwithstanding the fact that a day later the left chest posteriorly was found to be flat to percussion as high as

the angle of the scapula with tubular breathing and scattered râles

We will not attempt to trace the pathologic steps in an effort to interpret the physical findings in the chest, but you will be interested to find that this patient had a massive empyema at the time of her death which occurred twenty days from the time of the above notation.

On 11/15/23 the physical signs had changed materially, and Dr. Norris made the interesting observation that the left chest was flat and resistant to percussion the breath sounds were somewhat distant but definitely bronchial in type, and a few râles were audible Metallic crackle and bronchophony were quite definite The area of flatness spread around the flank gradually becoming less intense In the latter area breath sounds were loud wheezing and associated with musical rales The cardiac sounds were clear and regular and the heart normally placed

I will ask you to pay strict attention to the next development

On 11/17/23 there was a sudden rise in temperature accompanied by severe pain in the left hypochondrium The patient became delirious for several hours, but by the following day was somewhat improved Thereafter the signs of inflammation in the left renal area were much more marked

On 11/27/23, following irrigation of the kidney there was a severe chill and she again had great pain and distress in the left hypochondrium As the postmortem records show, the infection had spread far beyond the limits of the pyonephrotic sac, the pus having burrowed into the left chest and into the psoas muscle sheath No actual perforations of the walls of the pyonephrotic sac were found, nevertheless I think it altogether likely that the sudden severe attacks of pain in the left hypochondrium were symptomatic of extension of the infection, possibly aggravated in the last instance by pelvic lavage The patient died in delirium on 11/29/23

*Postmortem Record*—Prov anatomic diagnosis Primary fatal lesion Colon bacillus septicemia

Secondary or terminal lesions: Left pyonephrosis, empyema left chest, fibrinous pericarditis, acute splenic tumor, acute parenchymatous nephritis, cloudy swelling of liver, chronic pancreatitis.

Subsidiary findings: Mild chronic aortic endocarditis, atelectasis of left lung, left double ureter and pelvis, anomaly of right ureter, uterine fibroids

The body is that of an obese adult white female, 156 cm. in length and weighing 137 pounds.

*Peritoneal Cavity.*—On opening the abdomen a large excess of fat is noted. The liver extends to, but not below, the costal margin. On exploration of the upper left quadrant a large saccular mass is found, 17 x 10 x 8 cm. in size, occupying the left renal fossa and adherent to the diaphragm above and to the vertebral column in the midline. It occupies a retroperitoneal position. The mass is fluctuant and evidently filled with fluid. The left lobe of the liver and stomach are pushed toward the midline by this mass.

*Pleural Cavity*—The left chest is filled with a liter of foul-smelling fluid pus. The left lung is collapsed.

*Heart.*—The heart extends 8 cm. to the left and 3 cm. to the right of the midsternal line. The pericardium is covered with purulent exudate. On opening the pericardium it is seen filled with a light fibrinous exudate, and there is a slight excess of turbid straw-colored fluid present. The myocardium is somewhat pale in color and of soft consistency. The endocardium is of normal color and normal throughout except the leaflets of the aortic valve, which show a moderate sclerosis, but not enough to result in a stenosis or insufficiency. Immediately above the leaflets of this valve are several small patches of early atheroma. Circumference of valves: M. 11 cm., P. 7 cm., T. 12 cm., A. 7 cm. The heart weighs 400 grams.

*Lungs.*—The upper and middle lobe of the right lung are essentially normal. The lower lobe is moderately congested and dark red in color. The section surface is moist. No areas of consolidation are seen.

The left lung is small and atelectatic. It is covered with a

dense fibrinopurulent exudate When placed in water the lung sinks On section, the consistency is rubbery and uniformly dark gray in color, evidently containing no air

*Spleen*—There are dense adhesions between the capsule of the spleen and the diaphragm above and the mass in the left renal fossa below The pulp is soft and tears easily when the spleen is removed The cut surface is pale and the tissue semi fluid in consistency, evidently representing an acute splenic tumor with possible early suppuration It weighs 150 grams and measures 12 x 8 x 2 cm

*Stomach, Duodenum, Pancreas*—The stomach is distended, but is otherwise normal The pancreas is pale in color and of somewhat fibroid consistency Upon section, there seems to be an increase in interlobular connective tissue No other areas of degeneration are noticed

*Intestines*—The intestines are essentially normal

*Liver*—The surface of the liver is pale and irregularly mottled The edges are rounded Much congestion is present in the dependent portions Section surface is suggestive of an early cloudy swelling The liver weighs 1640 grams and measures 24 x 20 x 7 cm The gall bladder is distended with dark viscid bile

*Kidneys* (Fig 84)—Right The right kidney is dark red in color and soft in consistency The capsule strips easily, revealing a red granular surface On section the tissue is somewhat pale and shows irregular dark red striations suggestive of an acute nephritis *The right ureter is 36 cm in length The pelvis of the right kidney splits into two ureters which extend downward for 15 cm, at which point the ureters fuse The remaining 21 cm is single ureter* On attempting to free the mass which occupies the left renal fossa the wall of this mass, which is very thin is broken off in several places, freeing a large quantity of yellow foul smelling pus similar to that seen in the left pleura This collection of pus is seen burrowing into and extending down within the body of the left psoas muscle

Upon dissection it is seen to consist of a sac surrounding the remnants of the kidney 7 x 5 x 15 cm in size Section through

*this renal vestige reveals double pelvis, each with its own ureter. The lower pelvis is dilated 4 x 3 x 2 cm. in size and is filled with yellow foul-smelling pus, together with a large amount of fine sand-like concretions. The renal tissue is pale, showing an evident old pyelonephritis. The upper pelvis is practically normal in shape and its walls are somewhat thickened.*

*Pelvic Organs*—The ovaries are small and atrophic. The uterus is small and contains one subserous fibroid 1 cm. in diameter at the fundus, together with several smaller intra-mural fibroids.

The bladder wall is thickened and moderate trabeculation is present. The mucosa is dark red in color.

The rectum is essentially normal.

*Aorta*—The aorta is smooth throughout.

*Brain*—Not examined

*Discussion*—The question of treatment in this case when the patient first came under our care in 1921 resolved itself into a choice between pelvic lavage and some operative procedure. Dr. Reiff was strongly of the opinion that the medical complications already enumerated precluded the possibility of successful surgery. Nephrotomy alone among the various operative procedures was given serious consideration. Nevertheless, the possibility of successful heminephrectomy, the removal of the diseased lower segment of the left kidney with retention of the upper relatively normal segment, was a problem which held much fascination for us.

The duplex kidney is particularly liable to complications of a surgical nature, but it is only in the rarest instances that heminephrectomy is indicated either as a matter of choice or of expediency. Mertz (Mertz, H. O., Urol and Cut Rev, 22, 1918, 553-565). Idem, 25, 920, 636-642, collected 300 cases, of which only 80 (30 per cent) had pathologic complications. Müller (Zeitschr f Urol Chir., Berlin, July 31, 1922, 45, 141) mentions 20 cases in which heminephrectomy was performed, and Eisendrath (Annals of Surgery, 76, 4, 450 and 76, 5, 531) has tabulated a series of 80 cases with surgical complications affecting double kidneys, in 12 of which heminephrectomy was

performed successfully while in 6 others the operation was a failure. In 50 of Eisendrath's cases complete nephrectomy was done, and in the remaining 12 either pyelotomy or nephrotomy

I think that the operation of nephrotomy in the treatment of advanced pyonephrosis and especially in very bad risks is much neglected and that in attempting to remove the kidney as a primary procedure we often have fatalities that might have been avoided had we been content merely to drain instead of attempting the difficult removal of a large and adherent pus sac.

Of 144 cases of duplex kidney observed at the Mayo Clinic (Braasch, W. F., and Scholl A. J., *the Jour. of Urol.*, 86: 507-558), 54 (37.5 per cent) had definite pathologic complications. Thirty patients in this series were operated upon, with the following findings:

|  |   |
|--|---|
| Unilateral obstruction with hydronephrosis or pyonephrosis | 8 |
| Renal tuberculosis   | 6 |
| Renal calculus   | 7 |
| Ureteral calculus  | 3 |
| Atrophic pyelonephritis                                    | 4 |
| Ureter opening into vagina                                 | 1 |
| Ureter crossed by anomalous vessel                         | 1 |

In 4 of these cases primary heminephrectomy was performed with two failures. In one instance pain necessitated the removal of the remaining segment, while in the second case re-operation was necessary on account of infection. One successful case had multiple stones, the other hydronephrosis and hydro-ureter.

According to Braasch and Scholl, "the conservative resection (heminephrectomy) is permissible only in the presence of lithiasis early localized infection other than tuberculous, small hydronephrosis confined to one segment" (Harpster, C. M., Brown T. H. and Delcher, H. - *the Jour. of Urol.*, 86: 459-490) states, "Resection is of value in the tuberculous kidney," but immediately follows a quotation from Bruci (Ann de mal d'org. gen., 1961) to the effect that the bridge of tissue joining the

kidney and the apparently healthy kidney will be found on microscopic examination to contain miliary tubercles, an observation with which Mayo is thoroughly in accord.

Heminephrectomy is not to be considered, therefore, in the treatment of tuberculosis apparently confined to one-half of a double kidney except perhaps in those rare instances where the two kidneys are separated by a band of fibrous tissue. I know of no such case in which the operation has been performed, but Marion (Bull. et Mem. Soc. de Chir. de Par., 1908, 54, 905-908) removed a pyonephretic kidney which was attached to another kidney by a simple band of fibrous tissue, and Samuels (Samuels, A., Kern, R. and Sacks, L., Surgery, Gynecology, and Obstetrics, 35, 599) reports the excision of a supernumerary kidney which had a separate and distinct capsule and blood-supply and was drained by a separate ureter which opened into the vagina.

Schoonover (The Journal of Urology, 8, 2, 155) reports an instance of complete duplication of the right renal pelvis and ureter in a man of twenty-eight years, the lower half of the kidney being hydronephrotic and infected. The case seemed to be a suitable one for heminephrectomy, but this was found at the time of operation to be impossible for mechanical reasons.

This writer's indications for heminephrectomy are as follows:

*Localization of the infection to one segment*

Marked reduction of function in one segment with normal function of the other segment

Sufficient distance separating the two segments to permit bisection.

If ureterectomy is also indicated, the ureters must be separate, *i.e.*, they must not be inclosed in a common sheath.

It would be interesting to continue this brief discussion of the anatomic and pathologic problems involved in a surgical consideration of duplex kidney, but this would lead us too far afield of the case in point. One would say without hesitation after a glance at this specimen removed postmortem (Fig. 84), that heminephrectomy would have been impossible, but you must remember that we are viewing terminal pathology and

not the pathology as it existed three years ago when the patient first came to us at the Methodist Hospital

We have quoted Dr Mayo to the effect that late infections contraindicate heminephrectomy and in this case the infection could scarcely be considered early even in the beginning of her clinical symptomatology. Nevertheless the infection was essentially a chronic one, and, as the pyelogram shows, a considerable space existed between the two pelvis, and finally there was complete separation of the ureters (Fig. 83).

I would be unwilling to say that successful heminephrectomy would have been impossible in this case several years ago, I am quite sure that this question can be answered in a given case only after exploration and careful inspection of the abnormal structures.

**Case II Congenital Ectopia of the Kidney (Right) with Complete Torsion**—The case about to be presented represents an entirely different renal deformity than the foregoing, but one which we believe likewise to be of congenital origin. As the history and physical findings are described, you may question our conception of the origin of this defect, and not without reason for the diagnosis remains problematic.

This pyelogram (Fig. 86), made 11/2/23, is of absorbing interest. You will note first that the kidney is ectopic or ptozed and occupies a low position in the abdomen, second, that the pelvic outline is abnormal with marked elongation or retraction of the upper major calyx, and finally, that there is complete rotation of the kidney, the ureter emerging from the pelvis laterally with the calices pointing toward the midline.

The shadowgraph catheter on the left side reaches to the normal level of the kidney pelvis. This is an incomplete description of the pyelogram but it serves to establish the fact that we are dealing with a rotated ectopic right kidney, which seems to have no anatomic relationship with the left kidney.

*Clinical Record from the Out patient Department*—M. M., an Italian, twenty seven years of age, was admitted to the

Urological Out-patient Clinic in the Pennsylvania Hospital  
7/2/22.

*Chief Complaint—Pain in the back of one week's duration*  
Slight pain at the end of urination

No venereal history

Examination: Sexual organs normal. Urine negative.



Fig 86.—Pyelogram of an ectopic and rotated kidney. Note the position of the kidney, the lower pole of which occupies the false pelvis. The calices are pointing toward the midline, while the ureter comes from the lateral side of the kidney above the renal shadow (Fig. 87).

Skogram by Dr. Bowen

Urethra Meatus small; spasmoidic stricture (no record made of abnormal finding on abdominal palpation).

Treatment: The meatus was enlarged preparatory to cystoscopy.

x-Ray examination. "Negative except for slight enlargement of the right kidney."

This plate was misinterpreted, for on re-examination the en-

larged and ptosed kidney is clearly defined, so that it is obvious that the patient had an abnormal kidney at this time that would have been discovered in all probability had he been subjected to a more careful physical examination.

A cystoscopic examination was made on August 16, 1922, with the following findings:



Fig. 87.—Skiagram of ectopic and rotated kidney (right) (See Fig. 86.) The upper shadow we believe to be a malformed and probably ptosed liver, the lower shadow is the ectopic kidney. Plates by Dr. Bowen. Patient in the Medical Service of Dr. Norris in the Pennsylvania Hospital.

"The bladder is entirely normal. The urine from each kidney is normal and sterile. A differential functional study (1 c.c. phthalein intravenously) shows an appearance time of three and a half minutes from the right and three minutes from the left kidney. Each kidney eliminates 20 per cent of the dye during a period of fifteen minutes." This study was repeated a week later, when a few leukocytes and colon bacilli were recovered from each side. No mention is made of shortening of the right

ureter, the recognition of which would certainly have stimulated more careful investigation.

The patient was thought to have a transient mild pyelitis, which diagnosis is open to question, but it must not be forgotten that the abnormal kidney is very subject to mild attacks of pyelitis of the intermittent type. The patient left the clinic and now reappears as an in-patient in the medical service of Dr. Norris.

*House Record.*—Admitted 11/27/23, complaining of pain in the chest and burning in the "stomach."

The present trouble began four days before admission and is attributed by the patient to "getting wet." The disease came on abruptly with headache, dizziness, and weakness. Next day he had a severe chill lasting one hour. There was no nausea or vomiting. The headaches continued and an habitual constipation became more pronounced. For the relief of this he prescribed a cathartic for himself, the taking of which was followed by three liquid stools. There has been no nosebleed. The only urinary symptom has been slight frequency. The patient thinks he has had fever for the past two days.

About one year ago he first noticed pain in the form of a dull steady ache on the left renal area. This was much aggravated by drinking coffee and eating sweets. Two weeks ago a dull aching pain appeared in the right lower abdomen and he discovered a mass in the same area. The mass slowly increased in size and became tender to the touch. To the presence of this mass he ascribes the constipation which has necessitated cathartics three or more times weekly.

*Physical Examination* (from the House Physician's Report).—Temperature on admission, 101° F.; pulse, 108; respirations, 28. Head and neck normal except for cervical adenopathy. Chest negative. Abdomen: Liver edge palpable 3 cm. below the costal margin in the midclavicular line. No tenderness. The spleen can be felt on deep inspiration and is slightly tender. It is also enlarged to percussion. There is slight tenderness on deep pressure in the midepigastrium, a slightly tender mass the size of a small apple can be felt to the right of and below the umbilicus. The mass is rounded in outline and moves slightly on respiration.

tion. The left kidney cannot be felt. There is slight enlargement of the inguinal lymph-nodes.

*Impressions.*—(1) Typhoid fever; (2) acute nephritis; (3) renal tuberculosis.

Kidney functional test (phthalein intramuscularly): First hour, 30 per cent.; second hour, 20 per cent.; total elimination, 50 per cent.



Fig. 88.—Traumatic dislocation of the kidney. Note the normal shape, size, and contour of the pyelographic shadow. The ureter is of normal length, but folded upon itself as the result of the low position of the kidney. The dislocation followed a fall on the ice, immediately following which there was right-sided hematuria. The patient, an aged man, died as the result of the injury, the immediate cause of death being uremia. Case in the Urological Service of the Methodist Hospital of Philadelphia.

Blood: Hemoglobin, 85 per cent.; erythrocytes, 4,710,000; leukocytes, 8800.

Blood chemistry: Urea nitrogen, 17.6 mg.; creatinin, 1.4; sugar, 0.94.

On 11/29/23 Dr. William Stroud examined the patient and confirmed in the main the intern's findings, but suggested the possibility of ptosis and mobility of the right kidney, perhaps with malignancy of the kidney or adrenal gland. At this time

typhoid fever could not be ruled out. Dr. Norris, too, was unwilling to say that the patient did not have typhoid, although his examination failed to reveal the presence of rose-spots. However, the blood-culture proved to be negative, as did the Widal tests (*Bacillus typhosis* and *paratyphosis*, A and B), and the fever soon subsided. The urine at times contained a few leukocytes and a very few casts. The Wassermann test was negative.

*Cystoscopic Examination* (12/5/23, Dr Herman) —Nothing abnormal was noted in the bladder. The ureteral orifices were normal in position and appearance. The right ureter was found to be distinctly shorter than its fellow. No evidence of pelvic distention was obtained. On account of the patient's weakened condition it was thought best to make a hurried examination. Accordingly, the right renal pelvis was injected with 8 c.c. of sodium bromid solution, which caused some pain, and a pyelogram was made. Dr. Bowen reported as follows: "The right kidney is very much prolapsed and shows a deformity in its upper portion. There is complete rotation of the organ. The uppermost major calyx is unduly separated from its fellows, but does not show the results of compression. These findings are rather distinctly against hypernephroma and are more suggestive of congenital deformity. After careful re-examination of the plates made in July, 1922, I am convinced that a mistake was made at that time, and that the kidney was in practically the same position then that it now occupies" (Fig. 87).

*Cystoscopic Examination* (12/13/23).—"Careful search fails to reveal any supernumerary ureteral openings. Indigocarmine (10 c.c. intravenously) appears in an intense blue spurt from each ureteral orifice in four minutes, indicating normal functional capacity. The left pelvis was injected with 8 c.c. of 15 per cent. sodium bromid solution, and a pyelogram was made which is normal in all essential details. There is, however, some elongation of the upper major calyx, but this can be considered a normal variation. The left kidney is, functionally and structurally, a normal organ.

*Discussion.*—The febrile attack in this individual is probably

incidental. It may indicate a transient infection of the right kidney pelvis, a mild pyelitis, that has now been recovered from. The fact that the patient had pain in the right lower abdomen must be given due weight, but the slight tenderness elicited on pressure and the belief on the part of the patient



Fig 89.—Pyelogram of large hypernephroma of the right kidney. Patient of Dr. John Gibbon in the Pennsylvania Hospital. Note the marked retraction and compression of the major calices, and the absence of the normal "cupping" of the minor calices. The left pelvis is bifurcated, but otherwise normal. Pyelogram by Drs Klopp and Bowen. Successful nephrectomy by Dr. Gibbon.

that the self-discovered mass grew in size are observations that, in our opinion, have little significance

Our interest now centers in the origin and nature of the renal deformity. The clinical studies are sufficiently complete and we have been able to establish a number of important facts. The left kidney is undoubtedly normal in position, size, shape, and function. It is not infected. There is a congenital

variation in the contour of the pelvic outline, but this is without clinical significance.

The right kidney is ectopic and completely rotated, while the pelvis is manifestly abnormal in shape.

Ptosis of the kidney or kidneys, with or without torsion, may be either congenital or acquired. We will quote from a former paper (Herman, L., and Fetterolf, G., Annals of Surgery, Phila., 1913, lvii, 868) in explanation of the occurrence of the common types of congenital renal ectopia: "The primitive kidney is a pelvic organ derived from a portion of the paravertebral mesoblastic tissue of the pelvic wall, the renal blastema, and from the branching subdivisions of the expanded ends of the primitive ureter, which contribute that portion of the uriniferous tubular system represented by the straight collecting tubules. Each organ is formed independently and possibly as a result of change in the line of curvature of the caudal extremity of the spinal column, ascends, until by the end of the third month of fetal life, has reached its adult position. Fusion of the renal masses would cause retardation in the ascent, probably as a result of the development of the sacral promontory, which would offer obstruction to the midportion, and prevent the normal passage upward of the lateral masses along the ileolumbar grooves."

The foregoing explains satisfactorily the ectopic fused kidneys, but it cannot be applied to unilateral ectopia which Dorland (Surgery, Gynecology, and Obstetrics, 1911) thinks is due to late development of the ureteral bud from the Wolffian duct. Complete torsion of the kidney may be due to the failure of the organ to complete the last step in the normal rotation in its ascent. We have already noted the shortening of the ureter and the absence of kinks, which is almost positive proof that the ectopia in this instance is of congenital origin. Contrast the pyelogram (Fig. 86) with one of acquired ptosis (Fig. 88). The latter represents the kidney of an aged man who had a severe fall on the ice which was followed by right-sided hematuria. The picture shows a traumatically dislocated kidney with a tortuous and kinked ureter. An acquired renal ptosis with

complete torsion would almost certainly give rise to some degree of urinary stasis on the involved side, and result sooner or later in pelvic dilatation; in the case under discussion there is no enlargement of the pelvis and the function of the kidney is normal. We cannot discuss the many theories advanced to explain renal ectopia, but one hypothesis merits special consideration in connection with the case, namely, the presence of a mass



Fig. 90.—Torsion of the kidney of undetermined origin. The minor calices are pointing forward, the true pelvis is lying posterior. The kidney is very slightly psoas. Patient in the Pennsylvania Hospital of Philadelphia. Not operated. Pyelogram by Dr. Bowen.

occupying the renal fossa, which would preclude the normal ascent of the kidney. There is a shadow in this plate (Fig. 87) the significance of which we are at a loss to explain. If it is neoplastic and has been present since early fetal life, it must surely be benign. Is it a congenital anomaly of the liver, or perhaps a psoas liver? Please note that it resembles the kidney somewhat in outline and that the lower pole extends within 1

inch of the iliac crest. May it not be of adrenal origin? Is it a large solitary or single cyst springing from the upper pole of the kidney?

Dr. Bowen tells us that the upper shadow is suggestive of a renal shadow, and asks if there are two ureteral orifices on the right side of the vesicle trigone or other evidence of renal duality. If this is a congenitally fused kidney, the duality involves only the pelvis, for there is a single ureter. The normal round upper border of the ectopic kidney is fairly well shown in the skiagram, and there is very strong evidence against the presence of duplex kidney.

I think the probabilities of intrarenal growth can be ruled out because of the normal functional capacity of the kidney, the absence of compression of the elongated upper major calyx, and the presence of normally shaped minor calices. The pyelograms (Fig. 89) of large hyponephromata are unmistakable, but even in small tumors the minor calices are obliterated or markedly changed in form.

In the absence of exploratory operation the diagnosis remains problematic, but we will venture the opinion that this is a congenitally abnormal kidney, a kidney which is abnormal in position, completely rotated, and with incomplete duplication of the pelvis, or, if you prefer, an elongated upper major calyx, associated with a congenitally malformed and ptosed liver, the latter having prevented the normal ascent and rotation of the kidney during embryonic life.

## CLINIC OF DR I S RAVDIN

UNIVERSITY HOSPITAL

### REACTIONS IN TRANSFUSIONS

HARDLY a month passes that some one does not publish an article either pro or con one or another method of transfusion. In our clinic we have used the Kimpton Brown tube, the syringe cannula method, the citrate method, the Unger apparatus and a method the origin of which is variously claimed which consists of the transference of blood by the use of 100 cc Luer syringes. The number of patients transfused by all methods is just short of 1000 so that we feel we have given each method sufficient trial to note its advantages and disadvantages. The chief topic of controversy is that of posttransfusion reactions. In the last two years we have gone into this subject carefully and I would like to discuss our views with you.

There are certain factors which may cause reactions regardless of the method used and these I call

1 Universal Reactions —(a) Regardless of the method employed the donor and recipient must be carefully matched. I do not believe in depending on mere typing of both individuals. Any one who has transfused a large series of cases cannot but have been impressed by the fact that a percentage of the reactions is due to incompatibility of the bloods and not to the particular method employed. This type of reaction occurs regardless of whether the operator or a pathologist carries out the compatibility test.

Wherever possible the Group IV or universal donor should not be used for transfusion of any group except its own. Karsner and Dyke have proved that there is a variation in the agglutinating ability of serums in different individuals of the same group.

Recently at the Johns Hopkins Hospital it has been shown, what many of us had previously surmised, that there are sub-groups in each of the four major groups. This variation in the agglutinins explains the necessity for the cross-agglutination test. This has also been described by Bond in the British Medical Journal in 1917.

Just how many subgroups will eventually be found is now a matter of conjecture, but I venture to say they will be considerable. They may even be found to vary in the different diseases, certain lesions producing an alteration in the reaction of the cells and serum in that disease to the cells and serum of the healthy individual of the same general blood group. Various drugs, Roentgen rays, and general anesthesia have been reported by Vorschütz as changing the agglutinating properties of the serum. However, in a large series of cases in which transfusion was performed immediately after operation, no reactions were recorded. The subject is complex, and for this reason, except in an emergency, I always insist that a crossed agglutination and hemolysis test be done. This latter test should not be done by a haphazard, or so-called simplified technic, but the centrifuged serum and cells of donor and recipient should be accurately crossed. Disregard of this by the operator or pathologist is, I believe, the cause of a considerable portion of manifested reactions. The surgeon having reactions out of normal proportions should first have his serum checked and the method and accuracy of the typing and crossed agglutination investigated. I say crossed agglutination because I do not believe that hemolysis occurs in a degree sufficient to cause a reaction if no agglutination is present, while the reverse is not true.

(b) There are other conditions which may cause reactions regardless of the method used. It is extremely probable that alteration in the chemical contents of the blood-plasma in certain diseases, as in the severe anemias, may result in a reaction, anaphylactic in character, when blood of a normal individual is administered. It is also possible that this reaction may be due to variations in the hydrogen-ion concentration between the donor's and the recipient's blood. Investigations begun

along these lines lead us to suspect that this may be of considerable importance. Although, as I will show later, this latter factor may be increased or decreased, depending upon whether the modified or unmodified method is used, it is present to a degree in any method.

(c) The introduction of bacteria at the time of the transfusion, although unlikely, is yet possible, and should this occur, the presence of these organisms, be they pathogenic or non-pathogenic, may cause the subsequent chills and fever. Indeed, a condition such as this may account for some of the delayed reactions occasionally encountered. The chills and fever are then merely an external manifestation of the mobilization of the body forces to exterminate the invading offender. In the hands of those who do not regard transfusion as a serious procedure, and whose technic and asepsis is correspondingly poor, this factor should be borne in mind.

(d) Any method which does not permit of the rapid transference of the blood from donor to recipient will show a higher proportion of posttransfusion reactions. This may be due to minute agglutinating particles or, as I shall describe later, to a change in the chemical reaction of the blood as interpreted by the plasma carbon dioxide or the hydrogen-ion concentration.

(e) There is some difference of opinion as to whether or not repeated transfusions by any method subject the patient to the added danger of reaction. In our experience, however, we have found that the danger of reaction is in direct proportion to the number of transfusions the recipient has had previously. The reaction is very apt to occur if the same donor is used, since here specific agglutinins probably develop in the recipient's blood against the donor's cells. It would be safer to do a crossed agglutination test each time the donor is used for the same recipient.

(f) Auto-agglutinins may be present in cases of severe anemia or in patients who have had a number of transfusions over a short period. If the serum is allowed to separate from the blood at body temperature, antibodies may be demonstrated

which are not demonstrated when the serum is allowed to separate in the cold specimen. In these cases the serum will clump its own cells if they are tested at room temperature.

(g) Any method which allows for incipient coagulation changes may be a factor in the reaction. It is thought that certain anticoagulative substances have a greater tendency to modify the blood-platelets, but any method which does not permit of the rapid transference of the blood lays itself open to the charge that incipient coagulative changes have occurred that were not macroscopic in character.

2. Specific Reactions.—(a) Several years ago while advocating the citrate method (which we do not believe has outlived its usefulness in a large percentage of cases) we were struck by the fact that the number of reactions reported after the use of this method were far greater than we had encountered in our own cases. I then inquired of a number of surgeons as to the preparation of sodium citrate they were using. I was surprised to learn that very few had ever looked into this matter. There is only one preparation which can be used with safety, and that is a citrate of "reagent purity." The amounts of free lead, iron, and other substances in the ordinary commercial preparations makes their use extremely hazardous. After all the preceding precautions were observed, reactions were still obtained, and this instigated further research. We then found the following causes for some of our trouble:

(b) The distilled water used in the preparation of the citrate solution was not fresh. It is well known that any solution which has stood for a number of days on a shelf before its intravenous administration may cause a reaction similar in every detail to that observed after transfusion by any method. We have observed it a number of times after intravenous normal saline administration.

(c) Some hospitals do not distil their water, but buy commercial preparations sold in the larger cities. Several bottles were purchased and a variation was found in the hydrogen-ion concentration, some solutions being distinctly acid. Although the companies manufacturing these solutions are apparently

careful, nevertheless bottles are occasionally washed in an acid solution and they are not neutralized before they are filled

(d) Sodium citrate does not stand repeated sterilization We made up solutions and ran them through an autoclave on successive days, removing some after each sterilization for an estimation of the hydrogen ion concentration This gradually falls until after five days we were able to obtain an equivalent of nearly  $\frac{1}{2}$  of 1 per cent of free citric acid We were then tempted to use a fresh properly prepared solution of sodium citrate, to which we added the equivalent in free citric acid A violent reaction occurred I therefore believe that if the citrate method is employed it is preferable to weigh out the amount of sodium citrate necessary to make a 2 per cent solution when dissolved in 100 c.c. of freshly distilled water, and to put this in a sterile 100 c.c. flask tightly corked, the water to be added just before its use

(e) It is important that the blood from the donor be transferred as rapidly as possible to the recipient Exposure to the air over a long period of time allows for a reduction in the carbon dioxid content and for a greater alkalinity of the blood Although we have been unable to prove it, this decrease in plasma carbon dioxid and increase in alkalinity might be sufficient to cause reaction

(f) The flask should be washed out in the solution of sodium citrate and the remainder carefully dropped in as the blood is introduced, so that the initial blood entering the cylinder is not hemolyzed This undoubtedly occurs when large amounts of citrate are in the flask when the blood begins to flow into it

(g) Galland first showed the dangers resulting from the use of new rubber tubing, and this has since been called to our attention by the work at the Mayo Clinic by Busman This factor may result in reactions in either the citrate or the Unger method It is more apt to occur in that method which utilizes a large amount of tubing

From these facts we can conclude that no one cause or method is responsible for all reactions Reduction in post-transfusion reactions will depend upon careful attention to de-

tail and realization that the operation is not minor in character. It is true that with indifferent technic more reactions are to be expected with the citrate method, but if consideration is given to the specific causes of reaction when this method is used, the percentage of reactions will not be any greater than those encountered with the unmodified blood.

## CLINIC OF DR. FRANCIS C. GRANT

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### THE TREATMENT OF FRACTURED SKULL

In the past ten years the tendency in the treatment of cranial trauma has been toward conservative measures rather than immediate surgical interference. The high operative mortality that resulted from rushing all serious head injuries to the amphitheater and performing subtemporal decompression has produced a reaction in favor of a more careful consideration of the indications for surgery in these cases. Hitherto concussion and continued stupor with or without localizing signs pointing to the area of the brain injured seemed to most surgeons sufficient reason for immediate decompression. As a rule no attempt was made to try to estimate the degree or nature of the injury or to formulate any rule upon which to decide for or against operation.

The surgeon must realize his limitations in dealing with cranial trauma. By surgical means we cannot restore the function of a damaged cerebral cortex. A pulped and lacerated brain will recover what function it can spontaneously. Our efforts should be directed toward improving the conditions under which this recovery may take place.

Cases of cranial trauma may be divided roughly into three groups:

1. Those cases that die no matter what is done.
2. Those that recover spontaneously without treatment.
3. The intermediate group that will die if untreated, but which may be saved by intelligent and timely interference. In

<sup>1</sup> Clinical Lecture to the Surgical Group, Post-graduate School of Medicine, University of Pennsylvania.

the management of head injuries every effort should be made to determine to which of these three classes the patient belongs.

The injury to the cranial bones is the least important feature in this type of case. The prognosis depends in great measure on the damage that has been inflicted on the underlying nervous structures. A very extensive fracture of the vault that shows distinctly on the x-ray plate may produce relatively few clinical symptoms, while a short split in the base of the skull, invisible on the skiagram, is capable of causing alarming symptoms from involvement of the vital nerve centers about it. It is the presence of these vital centers that makes the prognosis of basilar fracture so much more serious than vault fracture.

Since we cannot restore the function of a damaged brain by surgical means, what are the indications for surgical interference in cases of cranial trauma? We believe that there are two: to prevent infection and to relieve an increase in the intracranial tension. These are the only factors that are amenable to our control.

From the point of view of intracranial tension, head injuries may be divided into two classes. Immediate operation is required in patients exhibiting symptoms of an increasing intracranial tension plus sufficient neurologic signs to determine with fair exactness the area of the brain involved. By immediate operation we mean any time after injury that the patient has rallied sufficiently from the shock of the injury to make operation justifiable. But intracranial tension alone without localizing signs we do not feel requires immediate operative intervention. This condition may be handled as effectively by other means, namely, lumbar puncture, hypertonic solutions by rectum or vein, and ventricular tap. Subtemporal decompression for relief of pressure is reserved as a last resort, and is rarely performed in the first forty-eight hours after injury. Cranial trauma is an acute condition. Treatment should be directed toward tiding the brain over the period of edema and swelling which follows the bruising from the injury. The brain is contained in a rigid bony box. The only opening of any size in the skull is at the

foramen magnum at the base of the brain. There is at the most only a potential space between the brain and its enveloping membranes and the surrounding bone. Hence any factor such as an injury which causes the brain to swell increases the intra cranial contents puts pressure equally on all parts of the brain and, because of the inelasticity of the skull above, forces the structures about the large foraminal opening at the base, down into the opening and against its bony walls. At the base of the brain lie the important vital centers controlling respiration and cardiac rate. As these centers are caught between the pressure from above and the bone beneath, their function is interfered with and the changes in respiratory and cardiac rate that accompany increasing intracranial tension are produced.

Reduction in the amount of cerebrospinal fluid in the cranial cavity will lower the intracranial pressure. Subtemporal decompression attempts to arrive at this result by allowing for the expansion of the intracranial contents through the bony opening and by the escape of the small amount of cerebrospinal fluid that occurs during the operation. Speaking broadly, in cases of cranial trauma, two conditions are encountered on removing the bone and incising the dura. In one class of cases on incising the dura a large amount of cerebrospinal fluid escapes. The subarachnoid space may be distended with fluid and on nicking this membrane in different areas still more fluid is liberated. It is in these cases with a wet brain that this operation produces the most definite relief of symptoms. Other patients offer a striking contrast. On incising the dura no fluid escapes. The subarachnoid space appears empty, the brain surface dusky and congested, and the intracranial pressure forces the brain out against the edges of the dural incision so tightly that the cortex effectively plugs the opening through which drainage might occur. So rapidly may this herniation of the brain take place that the operator may see the cerebral surface lacerated against the edges of the dural opening with the rupture of cortical veins and the production of annoying bleeding. Operative interference benefits the patient but little where a dry brain is found.

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and skin sutured in separate layers, and a rubber tissue drain inserted for twenty-four hours. The presence of a fracture, the edges of which are in good position and free from foreign material, requires no more extensive treatment. When foreign material is noted in the fracture line, both edges should be carefully rongeured away until the bone is clean. The wound is then swabbed out, sutured in layers, and drained with rubber tissue for twenty-four hours. A depressed fracture must be raised. It is usually necessary to enlarge the skin wound sufficiently to allow a small trephine opening to be made. The depression is raised from within outward by a suitable instrument passed through the trephine opening. If cerebrospinal fluid is seen escaping from the wound, the overlying bone must be removed to a sufficient extent to permit suture of the dural tear. A tight dural closure is the best safeguard against infection. After flooding the wound with an antiseptic, it is closed in layers and drained as described.

Our routine treatment of cranial cases is as follows: On admission, the pulse, respiration, temperature, and blood-pressure are obtained. If the blood-pressure registers below 60 mm. of mercury in systole or if the temperature is markedly subnormal, a state of shock is considered to exist. The head is lowered, external heat applied, and  $\frac{1}{2}$  ampule of pituitrin given by hypodermic. If external lacerations are noted, they are gently cleaned, packed if bleeding, flooded with dichloramin-T, and covered with sterile gauze. A solution of 2 ounces of magnesium sulphate crystals dissolved in 6 ounces of water is allowed to flow into the rectum. The head-down position aids in the retention of this solution. Nothing further is attempted until the temperature has regained the normal level and the blood-pressure has risen to above 60 mm. in systole. At this point x-ray plates are taken and a careful neurologic examination made. Next, any lacerations present are given proper care. A lumbar puncture is performed, with careful manometer readings of the pressure.

We are now in a position to determine what the next step shall be. We have the clinical picture, the degree of intracranial tension, and the appearance of the cerebrospinal fluid, and may

have information from the  $\alpha$ -ray to guide us. If the neurologic signs point definitely to one hemisphere, and to a certain area of that hemisphere, we expose that region. This applies only to signs pointing to cortical involvement. We do not decompress for relief of injuries to the base of the brain. That area is out of reach of surgery. Paralysis or definite weakness of one or both extremities on the same side, convulsions, jacksonian in type, motor or sensory aphasia, are the kind of localizing symptoms that we require to feel that operation is indicated. If the neurologic signs are vague and indefinite, we do not decompress, no matter how high the intracranial tension may be. All treatment is centered on the reduction of this pressure. If the first lumbar puncture showed a high pressure, enough fluid is withdrawn to reduce it. For example, if the pressure is not more than twice the normal of 10 mm. of mercury, sufficient fluid is removed to lower it to normal. If the increase is more than twice normal, say to 25 or 30 mm., fluid is drawn away until the tension is reduced one-half. If the initial pressure was very high or if the clinical signs do not improve, the spinal tap is repeated in eight hours and fluid removed as in the first instance. The patient receives a solution containing 2 ounces of magnesium sulphate crystals in 6 ounces of water, every four hours, by rectum.

All cases of cranial trauma are given these rectal injections. As a rule they are sufficient to prevent the manifestations of a rise in intracranial tension from appearing. If, however, the pulse and respiration rate continue to be depressed or become retarded and the pulse pressure—as shown by the blood-pressure readings—continues to rise until it equals the pulse-rate, then other steps are necessary to reduce the rising tension within the cranium. If the failing pulse and rising pulse-pressure are not accompanied by increasing stupor or depression of reflexes, 100 c.c. of a 15 per cent. solution of sodium chlorid are given by vein at the rate of 2 c.c. per minute. It is important to give this solution slowly. If stupor is advancing and the neurologic picture is changing for the worse, in addition to the administration of the salt solution, we believe that the posterior horn of

the lateral ventricle on one side should be tapped through Keen's point. This procedure is not difficult to one who is familiar with ventricular topography, relieves the pressure on the base of the brain directly from above rather than from below, as is the case in spinal tap, and does not leave more than a trephine opening in the skull.

By these measures we feel that we may avoid the necessity of decompression. This operation leaves the patient with a cranial defect which may lead to herniation making the defect difficult of closure and does not relieve the intracranial tension effectively. Hypertonic solutions, spinal and ventricular tap will do more for the relief of symptoms arising from a general increase of pressure than decompression will accomplish. We reserve this operation strictly for those cases in which the neurologic signs indicate definitely the localization of the area of pressure which may be reduced by exposure and removal of clot or fluid.

In the year ending November 1st last in the Allied Hospitals of the Postgraduate School of the University of Pennsylvania, 95 cases of cranial trauma were treated of such severity that hospitalization for at least twenty four hours seemed indicated. In 40 of these cases a history of unconsciousness lasting for at least five minutes was obtained. Nineteen cases showed demonstrable fractures on the x-ray films. Two of these cases showed no signs of concussion. In 2 cases the cerebrospinal fluid on lumbar puncture was bloody but roentgenologically the skull was negative for fracture. In 7 cases a basal fracture was demonstrated, in 12 a fracture of the vault. Of the 7 basal fractures, 5 recovered and 2 died. Ten of the vault fractures lived and 2 succumbed to their injuries. Five cases were operated, 3 for débridement of compounded vault fractures, 2 for relief of pressure one in a fracture of the vault and another of the base. Of the four vault fractures, 2 of the cases in which débridement was performed recovered. The operated basilar fracture case died. In this case and the compound vault fracture which perished the patients had other injuries and were in desperate condition.

This series is small. Probably another year's experience will bring our mortality in basal fractures of the skull up to the 40 or 50 per cent. reported by most observers. But we shall continue our treatment along the lines laid down, believing that we can accomplish at least as much by them as by immediate and indiscriminate operative interference.

